U.S. Department of Energy
National Nuclear Security Administration
Livermore Field Office, Livermore, California 94551

Lawrence Livermore National Laboratory
Lawrence Livermore National Security, LLC, Livermore, California 94551

LLNL-AR-653835

Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches Lawrence Livermore National Laboratory Site 300

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October 2014

***Weiss Associates, Emeryville CA**

Environmental Restoration Department

This work performed under the auspices of the U.S. Department of Energy/National Nuclear Security Administration by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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1. Introduction

1.1. Purpose

This work plan describes the activities proposed to characterize semivolatile organic compounds (SVOCs)/polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in subsurface soil in the vicinity of the debris burial trenches in the Eastern General Services Area (GSA) portion of the GSA Operable Unit (OU 1) at Lawrence Livermore National Laboratory (LLNL) Site 300. The locations of Site 300 and the GSA OU are shown in Figure 1.

In June 2013, the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) submitted the "Draft Final Close Out Report to document completion of remediation for the Eastern GSA Subarea of OU 1". At the July 18, 2013 Remedial Project Manager's (RPM) Meeting, the U.S. Environmental Protection Agency (EPA) and the California Regional Water Quality Control Board (RWQCB) indicated that they felt that there were data gaps for SVOCs/PAHs and PCBs in subsurface soil in the vicinity of the debris burial trenches that needed to be addressed. The EPA indicated that the lack of sampling for SVOCs/PAHs and PCBs in subsurface soil during the remediation investigation of the debris burial trenches indicated a data gap because:

1. The EPA Guidance for conducting Remedial Investigations and Feasibility Studies for Landfills indicates that analytes should be taken from the Target Compound List and Target Analyte List, which includes SVOCs and PAHs.
2. Solvents may have been used by the craft shops to remove machining or cutting oils and cutting oils historically contained PCBs.

The RWQCB expressed concern that, although SVOCs and PCBs have never been detected in Eastern GSA ground water, if these constituents were associated with the craft shop debris buried in the trenches, they might impact ground water in the future. The U.S. EPA and the RWQCB indicated that they would not consider closure of the Eastern GSA site until these data gaps were closed. Therefore, DOE/NNSA agreed to collect additional subsurface soil samples from the Eastern GSA debris burial trenches for SVOC/PAH and PCB analysis to determine if these constituents are present, and if present, to determine whether or not the concentrations of these constituents could impact ground water above Maximum Contaminant Levels (MCLs).

The LLNL Environmental Restoration Department (ERD) will conduct this work for the DOE in accordance with the existing plans and procedures developed for LLNL's ongoing Site 300 assessment and site cleanup under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

CERCLA activities at LLNL Site 300 are overseen by the U.S. EPA, California Department of Toxic Substances Control (DTSC), and the RWQCB – Central Valley Region.

1.2. Project Objectives

The objective of the activities outlined in this work plan is to determine: (1) if SVOCs/PAHs and PCBs are present in subsurface soil in the Eastern GSA debris burial trenches, and (2) if present, the potential for these constituents to pose an unacceptable risk or to impact ground water at concentrations above MCLs.

1.3. Summary of Scope of Work

The activities to be conducted to achieve the objective stated in Section 1.2 includes:

- Drill 12 boreholes to a depth of 15 feet (ft) below ground surface (bgs) within the Eastern GSA debris burial trench area.
- Collect subsurface soil samples at 5, 10, and 15 ft bgs from each borehole for SVOC/PAH and PCB analyses.
- If SVOC/PAHs or PCBs are present in subsurface soil, evaluate the constituents detected against regulatory screening levels, and if necessary, assess the risk and potential threat to ground water using site-specific data.

The details of these activities and the methods that will be used to conduct them are discussed in Section 3.

1.4. Data Quality Objectives

The EPA's Data Quality Objectives (DQOs) Process is a series of seven logical steps that guides planners to the resource-effective acquisition of environmental data. The DQO process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. Use of the DQO process leads to efficient and effective expenditure of resources; consensus on the type, quality, and quantity of data needed to meet the project goals; and appropriate documentation of actions taken during the development of the project. The ERD conducts its work projects in accordance with the approved Quality Assurance Project Plan (QAPP) (Dibley, 1999) requirements for planning, performing, documenting, and verifying the quality of activities and data. The QAPP was prepared for CERCLA compliance and ensures that the precision, accuracy, completeness, and representativeness of project data are known and are of acceptable quality. The QAPP is used in conjunction with the LLNL ERD Standard Operating Procedures (SOPs), Work Plans, Integration Work Sheets (IWSs), Site Safety Plans, and any other applicable Environmental Safety and Health (ES&H) and/or quality assurance (QA) documentation. Additionally, for the investigations described in this work plan, the EPA guidance "Systematic Planning Using the DQO Process" (EPA, 2006) was followed. Table 1 summarizes the specific DQO steps and corresponding information for the proposed Eastern GSA Debris Burial Trench characterization activities. Additional information regarding QA/quality control (QC) procedures is included in Section 5 and Attachment A.

2. Site History Summary

The following sections provide descriptions of the site setting, geology and hydrogeology, previous investigations, and remedial actions conducted to date in the Eastern GSA. Additional information can be found in the Site-Wide Remedial Investigation (Webster-Scholten, 1994), GSA Feasibility Study (Rueth and Berry, 1995), GSA Record of Decision (ROD) (U.S. DOE, 1997), GSA Remedial Design (Rueth et al., 1998), GSA Five-Year Reviews (Ferry et al., 2001, Dibley et al., 2006, and Valett et al., 2011) and the Draft Final Close Out Report for the Eastern GSA Subarea (Dibley and Ferry, 2013).

2.1. Site Description

LLNL Site 300 is a U.S. DOE experimental test facility operated by the Lawrence Livermore National Security (LLNS), Limited Liability Corporation. Site 300 is approximately 11 square miles and located in the Eastern Altamont Hills, 17 miles east of Livermore, California (Figure 1). At Site 300, DOE conducts research, development, and testing associated with high-explosive materials. During previous Site 300 operations, a number of contaminants were released to the environment.

The GSA OU is located in the southeast corner of Site 300 (Figure 1). The GSA has been separated into the Central GSA and the Eastern GSA based on differences in hydrogeology and the distribution of environmental contaminants (Figure 2). Only the Eastern GSA portion of the OU is relevant to and is discussed in this work plan.

The Eastern GSA area is largely undeveloped. Structures within or near the Eastern GSA include a pond that is used to treat sewage generated by shops and offices in the Central GSA, and an overflow pond east of the sewage pond. Debris burial trenches, that were used to dispose of craft shop debris in the 1960s and early 1970s, are located immediately north of the overflow pond. Other structures present in the Eastern GSA include former ground water extraction and monitor wells and a ground water treatment system that were used to extract, monitor, and treat contaminated ground water prior to the achievement of cleanup standards in 2007. There are also several dirt roads in the area that were constructed to access the sewage and overflow pond, and treatment facility and extraction wellfield. The current land use in the Eastern GSA is industrial. The Eastern GSA, as well as most of Site 300, has also been designated as critical habitat for protected wildlife resources. Offsite property adjacent to the Eastern GSA includes privately owned rangeland and a residence to the south, and an ecological preserve owned by the California Department of Fish and Game.

Evidence of a chemical release to ground water in the GSA was first discovered in 1982 when trichloroethylene (TCE) was detected in Well 7, a former onsite Site 300 water-supply well located in the Central GSA. Further investigations led to the discovery and investigation of several other release areas in the GSA, including the debris burial trenches in the Eastern GSA. In the 1960s and 1970s, volatile organic compound (VOC)-contaminated debris was buried in trenches located in the Eastern GSA causing VOC contamination of ground water and subsurface soil (Figure 3).

In 1991, ground water extraction and treatment began in the Eastern GSA as a time-critical removal action. In June 1992, the U.S. EPA, the California DTSC and RWQCB, and DOE signed a Federal Facility Agreement (FFA) for the cleanup of LLNL Site 300. The Site-Wide

Remedial Investigation report (Webster-Scholten, 1994) was issued in 1994, followed by the Feasibility Study for the GSA OU (Rueth et al., 1995) and Proposed Plan for Environmental Cleanup of the GSA OU (U.S. DOE, 1996). An OU-specific ROD for the GSA OU was signed in January 1997 (U.S. DOE, 1997).

The Remedial Design for the GSA OU was issued in 1998 (Rueth et al., 1998). Remedial action construction completion was documented in June 2005. EPA performed a construction completion inspection on July 13, 2005. Five-Year Reviews were completed in 2001 (Ferry et al., 2001), 2006 (Dibley et al., 2006), and 2011 (Valett et al., 2011).

Remediation efforts in the Eastern GSA successfully reduced concentrations of VOCs in ground water to below the cleanup standards set in the GSA ROD, and the Eastern GSA ground water extraction and treatment system was shut off on February 15, 2007 with regulatory approval. As required by the GSA ROD, ground water monitoring was conducted for five years after shutdown to determine if VOC concentrations would rise or "rebound" above cleanup standards. The results of the monitoring, which confirmed that VOC concentrations had remained below cleanup standards in the five-year post shutdown monitoring period, were presented at the February 24, 2012 RPM Meeting. The regulatory agencies agreed that cleanup of the Eastern GSA was complete, monitoring and reporting could cease, and that close out documentation should be submitted.

Draft and Draft Final Close Out Reports, documenting that remediation of the Eastern GSA portion of the GSA OU had been completed, were submitted to the regulatory agencies in December 2012 and June 2013, respectively. As discussed in Section 1.1, following submittal of the Draft Close Out Report in June 2013, EPA and the RWQCB requested and DOE agreed to collect additional subsurface soil samples from the Eastern GSA debris burial trench area for SVOC/PAH and PCB analysis to determine if these constituents are present, and if present, whether the concentrations of these constituents represent an unacceptable risk and/or could impact ground water above MCLs.

2.2. Hydrogeologic Setting

This section describes the general hydrogeologic setting for the Eastern GSA portion of the GSA OU including the unsaturated zone and the hydrostratigraphic units (HSUs) underlying the area.

2.2.1. Vadose (Unsaturated) Zone

In the eastern portion of the Central GSA (near the sewage treatment pond) and the Eastern GSA, the vadose zone is comprised of the unsaturated portion of the Quaternary alluvial (Qal) silty clay, sand, and gravel deposits and the underlying Tertiary Neroly Lower Blue Sandstone ($Tnbs_1$). In the Eastern GSA, these deposits are unsaturated to a depth of approximately 10 to 15 ft bgs. There is no significant contamination present in the unsaturated Qal and $Tnbs_1$ units in the Eastern GSA.

2.2.2. Saturated Zone

An HSU consists of one or more stratigraphic intervals that comprise a water-bearing zone exhibiting similar hydraulic and geochemical properties. There are two primary HSUs beneath the Eastern GSA: one shallow HSU and one deeper HSU.

The shallow HSU consists of the Qal-$Tnbs_1$ HSU, a water-bearing zone that is present throughout the Eastern GSA. This HSU is comprised of Qal deposits and the portion of the underlying Neroly $Tnbs_1$ bedrock unit that is in direct hydraulic communication with the Qal. The depth to ground water in Qal-$Tnbs_1$ HSU is 10 to 20 ft bgs depending on seasonal rainfall. Ground water in this HSU generally flows toward the east and north along the Corral Hollow Creek drainage at a velocity of 0.5 to 3 ft/day.

The deeper HSU consists of the regional Neroly $Tnbs_1$ bedrock aquifer. Depth to ground water in the $Tnbs_1$ HSU in the Eastern GSA varies from 10 to 25 ft bgs depending primarily on seasonal rainfall. Ground water generally flows to the south-southeast at a velocity of approximately 0.3 ft/day in the $Tnbs_1$ regional aquifer. Historically, contaminants have not been detected in the $Tnbs_1$ HSU, or have only sporadically been detected at low concentrations.

2.3. Previous Investigations

As discussed in Section 2.1, DOE began environmental investigations in the GSA in 1982. Review of historical records and photographs and interviews with present, former, and retired LLNL employees were conducted to identify and evaluate activities conducted in the Eastern GSA that may have resulted in contaminant releases. These record reviews and employee interviews indicated that debris generated in Central GSA craft shops had been buried in trenches in the Eastern GSA during the 1960s and 1970s. The approximate location of the Eastern GSA Debris Burial Trenches are shown on Figure 2.

To better determine the exact location of the debris burial trenches, DOE/LLNL used historical air photo interpretation, soil vapor surveys, and magnetic and ground penetrating radar (GPR) surveys. An air photo taken in the 1960s showed one trench and two other possible trenches where debris was buried (Figure 4). None of the trenches were visible in air photo taken in 1976, indicating that use of the trenches had been discontinued. Based on the air photo interpretations and employee interviews, the debris burial trenches consisted of a series of 2 to 3 trenches thought to range in size from 150 ft long by 20 ft wide to 30 ft long by 10 ft wide. The maximum depth of these trenches was approximately 10 ft. Active vapor induced and passive soil vapor surveys were conducted in the area to try and identify areas of elevated VOCs in soil vapor. In addition, magnetic and GPR surveys were conducted in the vicinity of the debris burial trenches to identify areas where metal containers or drums, and iron-containing debris might be buried, as well as to help determine the exact locations and sizes of the debris burial trenches.

Based on the results of the air photo interpretations, employee interviews, soil vapor surveys, and magnetic/GPR surveys, six test pits were excavated within the Eastern GSA debris burial trenches in 1990 to verify the nature of the debris placed in the trenches, and to collect soil samples to determine nature and extent of contamination in the debris burial trench area (Figure 5). As shown on Figure 5, the test pits were located to correspond with vertical magnetic gradient anomalies. It was verified that the trenches contained craft shop debris, such as scrap metal, lathe turnings, porcelain shards, electrical wire, assorted metal pipes, and glass (Figure 6).

Craft shop debris was encountered in five of the six test pits. This material had been mixed with soil during placement. The results of the magnetic/GPR surveys, which indicated that drums or metal containers were not present in the trenches, was confirmed by the test pit excavations.

Soil samples collected from the test pits were analyzed for VOCs. The VOC analytical results for these soil samples indicated the presence of very low levels of TCE (0.0009 milligrams per kilogram [mg/kg]), tetrachloroethene (PCE) (0.0013 mg/kg), 1,1,2,2-tetrachloroethane (PCA) (0.0002 mg/kg), dichlorobenzene (0.0002-0.0003 mg/kg), chloroform (0.0005 mg/kg), and Freon 113 (0.0002 mg/kg) in one of the test pits. No other VOCs were detected above the reporting limit in any of the other test pit soil samples, with the exception of TCE detected at the 0.0001 mg/kg reporting limit in a soil sample from test pit #5. Although craft shop debris was also encountered in three of the other test pits, no VOCs were detected above the 0.0001 mg/kg reporting limit in samples from these pits. No debris was encountered and no VOCs were detected above the 0.0001 mg/kg reporting limit in the sample from the sixth test pit. The concentrations of TCE, PCE, 1,1,2,2-PCA, dichlorobenzene, chloroform, and Freon 113 detected in soil samples from the test pits are all well below the most recent (November 2012) EPA industrial and residential soil Regional Screening Levels (RSLs) and the MCL protection of ground water soil screening levels.

As part of the remedial investigation of the Eastern GSA, DOE/LLNL also collected and analyzed samples of surface soil and subsurface soil from boreholes for VOCs and metals, including samples from within the debris burial trenches. Within the Eastern GSA debris burial trench area, 57 soil samples were collected from the vadose zone (0 to 30 ft bgs) in 7 boreholes. All VOC soil detections were below both the residential and industrial soil RSLs (April 2012) that incorporate the recently revised TCE toxicity value. Thirty-nine onsite and offsite monitor wells were also installed in the Eastern GSA to characterize the vertical and horizontal extent of ground water contamination and to determine ground water flow direction and gradient.

A Site-Wide Remedial Investigation (SWRI) report that summarized the results of characterization of Site 300, including the GSA OU, was issued in 1994. The remedial investigation concluded that the debris in the burial trenches, which was contaminated with small quantities of VOCs, was the source/release site for VOCs detected in Eastern GSA soil and ground water.

The results of remedial investigation and baseline risk assessment identified VOCs in ground water as the only contaminants and environmental media of concern in the Eastern GSA. TCE was identified as the primary contaminant of concern (COC) in Eastern GSA ground water, comprising approximately 90% of the total VOCs detected. Other COCs in ground water included PCE, cis-1,2-dichloroethene (DCE), 1,1-DCE, chloroform and bromodichloromethane. The highest concentrations of VOC contaminants in Eastern GSA ground water were detected in the vicinity of the debris burial trenches. The highest pre-remediation concentrations of total VOCs and TCE detected in shallow ground water near the debris burial trench were approximately 74 micrograms per liter (µg/L) and 71 µg/L, respectively in 1992. Prior to the start of remediation, the plume of TCE in ground water exceeding the 5 micrograms per liter (µg/L) MCL extended approximately 4,200 ft offsite.

The baseline human health risk assessment for the Eastern GSA estimated an excess carcinogenic risk of 5×10^{-5} for ingesting ground water from a hypothetical water-supply well located at the site boundary near the debris burial trenches. The risk associated with potential use of contaminated ground water at two existing offsite water-supply wells (CDF1 and SR1) was approximately 10^{-5}. These risks were calculated assuming that no remedial actions were taken and the VOCs in Eastern GSA ground water migrated to these wells.

The baseline human health risk assessment indicated that there was no unacceptable risk or hazard associated with potential exposure to VOCs in surface or subsurface soil in the Eastern GSA, and no contaminants of concern were identified in these media. There is no surface water present in the Eastern GSA.

The historic maximum TCE concentration in unsaturated soil/rock in the Eastern GSA (0.024 milligrams per kilogram [mg/kg]) is also below both the residential and industrial soil RSLs (April 2012) that incorporate the recently revised TCE toxicity value. The EPA residential soil RSLs (November 2012) for TCE are 0.91 mg/kg (cancer risk) and 4.4 mg/kg (non-cancer effects); the industrial soil RSLs (November 2012) for TCE are 6.4 mg/kg (cancer risk) and 20 mg/kg (non-cancer effects).

The SWRI risk assessment determined that VOCs and metals in soil, including samples collected from the debris burial trenches/area, did not pose an unacceptable risk or hazard to human or ecological receptors, or a further threat to ground water. As a result, VOCs and metals were not designated as contaminants of concern in surface or subsurface soil in the Eastern GSA. Therefore, capping of or other remedial measures for the debris burial trenches were not deemed necessary by DOE, the U.S. EPA, the California DTSC, and the RWQCB, and it was not included as alternative in the GSA Feasibility Study or as a component of the selected remedy in the GSA ROD.

The fact that there was no rebound of VOCs in ground water above the MCL cleanup standard in over five years of monitoring following treatment system shutdown, and that VOC concentrations continued to decrease towards reporting limits during this time, provides further evidence that the debris burial trenches are not a significant continued source of VOCs to Eastern GSA ground water.

No unacceptable risk or hazard was identified for ecological receptors in the baseline risk assessment.

In 1995, a Feasibility Study for the GSA OU that evaluated remedial alternatives for cleanup was issued. A Proposed Plan for Environmental Cleanup of the GSA OU was issued in 1996 for the public to review and comment on the remedial alternatives and proposed cleanup remedy and standards.

2.4. Remedial Actions To Date

Ground water extraction and treatment in the Eastern GSA to remove TCE and other VOCs began as a non-time-critical removal action in 1991 and continued as a remedial action after the GSA ROD was signed in 1997. In addition to ground water extraction and treatment, monitoring of ground water was conducted to evaluate the effectiveness of the remedy in achieving cleanup standards, and to ensure there is no impact to downgradient water-supply wells. The treatment facility influent and effluent were monitored to ensure compliance with the treatment facility effluent discharge limits. The effluent receiving surface water in Corral Hollow Creek was also monitored to evaluate potential surface water quality impacts. Figure 7 presents a site map of the Eastern GSA portion of the GSA OU 1 showing monitor, extraction, and water-supply wells, and the former ground water extraction and treatment facility.

A Risk and Hazard Management Program, including institutional/land use controls, was also implemented to prevent human exposure to contamination and to protect the integrity of the remedy. As discussed in Section 2.3, the only unacceptable risk identified in the baseline human health risk assessment for the Eastern GSA was associated with the potential ingestion of ground water containing VOCs at concentrations exceeding MCLs (cleanup standards). Because the MCL cleanup standards are protective under a residential and unrestricted land use, the only institutional/land use control that was applicable to the Eastern GSA was to prevent water-supply use/consumption of contaminated ground water until ground water cleanup standards were met.

By July of 2005, the concentrations of all individual VOC COCs had been reduced to below their ground water cleanup standards in all Eastern GSA wells. In February 2007, the Eastern GSA ground water extraction and treatment system was shut down and placed on standby with regulatory concurrence. VOC concentrations in ground water were monitored from February 2007 until February 2012 to verify that concentrations did not rebound above cleanup standards. From 1991 to 2007, over 300 million gallons of Eastern GSA ground water were extracted and treated.

3. Proposed Additional Characterization Activities and Methods

As discussed in Section 1.2, the objective of the activities described in this section is to determine if SVOCs/PAHs and PCBs are present in subsurface soil in the Eastern GSA debris burial trenches, and if so, if concentrations of these constituents could pose an unacceptable risk or impact ground water above MCLs. This section presents the Data Quality Objective Needs (Section 3.1.), Scope of Work including a description of borehole drilling, soil sampling, and analytical methods (Section 3.2), Safety Procedures (Section 3.3), Contaminant Control and Sampling Equipment Decontamination Procedures (Section 3.4), Sample Control, Sample Control, and Data Control (Section 3.5), and Quality Assurance/Quality Control (Section 3.6).

3.1. Data Quality Objective Needs

For the soil sampling described in this work plan, the EPA's "Guidance on Systematic Planning Using the DQO Process" (EPA, 2006) was followed. Table 1 summarizes the specific DQO steps and corresponding information. The DQOs specifically address the goal of filling the data gap described in Section 1.1 of the work plan. If SVOCs/PAHs or PCBs are found, further assessments will be necessary. Such assessments are not addressed in these DQOs (these DQOs may in that case become the first step of an iterative DQO process.)

3.2. Scope of Work

Scope of work for the characterization of SVOCs (including PAHs) and PCBs in subsurface soil in the Eastern GSA debris burial trench area includes drilling, sampling, laboratory analysis, and data analysis. Each of these elements is described in more detail in Sections 3.2.1 through 3.2.4.

3.2.1. Borehole Drilling

The 150 ft x 200 ft study area boundaries shown in Figure 8 were determined based on the known and potential locations of the Eastern GSA debris burial trenches identified through:

- Analysis of historical aerial photographs.
- Information presented in previous reports documenting investigations conducted in the debris burial trench area (i.e., SWRI, [1994], Wade et al., 1991).
- Data from previously drilled and sampled boreholes and ground water monitor wells.
- Data and information from the 1990 test pit excavation and sampling effort (Wade et al., 1991).

Based on this information, there is a high level of confidence that the perimeter of the Eastern GSA debris burial trench study area shown in Figure 8 is accurately located. For example, the air photo shows open trenches located north of Corral Hollow Road, immediately west of a north-south fence line and east of the sewage treatment pond. All of these features still exist today. Also, there is no evidence of any soil disturbance east of the fence line. The use of this area for debris burial likely ended before construction of the sewage treatment overflow pond in 1972.

Based on a discussion with EPA, DTSC, and the RWQCB at the July 22nd, 2014 RPM meeting, DOE and the regulatory agencies agreed that:

- Six boreholes would be drilled within the known debris burial trench locations as requested in regulatory comments on the draft work plan.
- Six boreholes would be drilled in the locations of the 1990 test pits where metal and/or VOC soil contamination were encountered.

The regulatory agencies concurred that this approach would result in the highest probability of detecting SVOC, PAH, and PCB contamination, if present, in subsurface soil in the debris burial trench area.

On August 1, 2014, DOE/LLNL provided a map of the new borehole locations based on this agreed-upon approach. On August 11 and 12, 2014, the regulatory agencies concurred with the new locations that are presented in Figure 9 of this work plan.

Figure 9 presents the location of the 12 boreholes from which subsurface soil samples will be collected and analyzed. These boreholes are located within the boundaries of the debris burial trench study area shown on Figures 8 and 9. The borehole locations will be located using a Trimble Pathfinder Pro XR Global Positioning System (GPS) device. Some location adjustments of a few feet (<10 ft) may be required due to subsurface utilities, endangered species critical habitat, drill rig access logistics, and/or slope/soil stability issues.

The boreholes will be drilled in accordance with LLNL drilling-related SOPs (Table 2) with a Rhino M5T track-mounted hollow stem auger rig to a maximum depth of: (1) 15 ft bgs or (2) auger refusal. The 15 ft borehole depth was selected to allow for sampling both within the trenches (0 to 10 ft) and the vadose zone (10 to 15 ft) beneath the trenches. The test pits that were excavated using a backhoe during the Eastern GSA debris burial trench Remedial Investigation (RI) fieldwork encountered Neroly bedrock at 4 to 8 ft bgs. It is not likely that unweathered Neroly bedrock that could result in auger refusal will be encountered at or above 15 feet below ground surface in any of the proposed boreholes. However, if bedrock is encountered that results in auger refusal, a decision will be made based on borehole depth whether to relocate and drill a new borehole in a nearby more favorable location or to collect samples from the deepest portion of this borehole for PAH, SVOC, and PCB analyses.

If auger refusal is caused by a large metal object, then the soil cuttings from the refusal depth will submitted for SVOC, PAH, and PCB analyses. A decision will be made at that time based on borehole depth whether to drill a new borehole in a nearby more favorable location.

Depending on season and annual rainfall, ground water depth beneath the Eastern GSA debris burial trench area varies from 10 and 20 ft bgs. The average ground water depth beneath the Eastern GSA debris burial trench area is about 15 ft bgs. It is not anticipated that ground water will be encountered during drilling, however depth to ground water would be recorded if encountered.

A drilling geologist will be present during the drilling of the boreholes to log the cuttings to provide information on the lithology and any metal or other debris that are encountered during drilling, and to verify the depth of the debris burial trench. Any soil associated with metal debris will be sampled and submitted for SVOC, PAH, and PCB analyses.

The boreholes will be drilled to a diameter of 6 inches (in). Cuttings from each borehole will constitute a maximum volume of about 3 cubic feet, before subtracting any soil collected for chemical analysis. Auger cuttings will be placed on plastic sheeting adjacent to the borehole during drilling and sampling activities. Upon reaching the total depth of the borehole or auger refusal and after soil sampling is completed, the boreholes will be backfilled with cuttings of origin and the surface topped with hydrated bentonite. The total volume of cuttings is expected to be less than 2.5 ft^3 per borehole given the 6-inch auger diameter, 15 foot total depth, and amount of soil removed for samples. It is expected that all auger cuttings will be returned to the borehole of origin. If there are any excess cuttings that cannot be returned to the borehole, it will be containerized, marked with borehole name, depth, and date, and submitted to the LLNL Radioactive and Hazardous Waste Management (RHWM) Division for characterization and disposal**.** The soil containers will be placed in an onsite waste accumulation area while awaiting characterization results. RHWM's characterization results for any excess soil cuttings will be used to determine the appropriate soil disposal method. For example, uncontaminated soil will either be reused onsite or disposed at a sanitary landfill. Contaminated soil will be disposed of at an appropriate landfill or disposal facility based on the contaminants and concentrations detected.

3.2.2. Soil Sampling

Soil samples will be collected in each of the 12 boreholes in accordance with the procedures specified in the LLNL borehole soil sampling-related SOPs (Table 2). Within each of the 12 boreholes, a hammered split-spoon soil sampler will be driven to collect soil samples at three depths: 5 ft, 10 ft and 15 ft below grade. Sample collection depths were selected to derive data from: (1) within the debris burial trench (5 ft), (2) at the bottom of the debris burial trenches (10 ft), and (3) the vadose zone beneath the debris burial trenches (15 ft). Soil/rock samples will be retained in 2.5-inch (in) diameter x 6-in long brass or steel liners. One 6-in sample will be collected just above each of these three sampling depths in each borehole for VOC monitoring with a hand held Organic Vapor Analyzer and to be used by the drilling geologist to describe lithology. Two 6-in samples will be collected at each of these three depths in each borehole for SVOC/PAH and PCB analysis as specified in Section 3.2.3. If metal debris is encountered in any of the boreholes, samples from that depth will be submitted for analysis. In addition, a total of four duplicate subsurface soil samples will be collected from different randomly-selected boreholes for QA/QC purposes. Each of these duplicate samples will be split into two samples and placed in separate Qorpak jars after the soil has been thoroughly mixed and homogenized. Three of the splits will be used for inter-laboratory comparisons and three will be used for intra-laboratory comparisons. The three intra-laboratory splits will be given surrogate sample identifications.

All sample liners will be marked and labeled (location, depth, date/time, etc.) and capped for laboratory analysis. Sample control and documentation will be conducted in accordance with the procedures described in Appendix A.

In addition to duplicate soil samples, other QA/QC samples to be collected in the field include:

- Trip blanks provided by the analytical laboratory that will be submitted with each chain-of-custody sheet.
- A field blank to be poured at the sampling location to identify contamination that may occur during the sample collection process.
- Equipment (rinsate) blanks collected during the equipment decontamination procedure.

As described in Section B-1.3.2.2 (Appendix B), the laboratory performing the sample analyses will perform and provide the results for method blank and matrix spike/matrix spike duplicate analyses.

3.2.3. Laboratory Analysis

Soil samples will be handled and transported to an offsite analytical laboratory in accordance with the procedures specified in the LLNL SOPs related to sample handling and management (Table 2). A total of 40 subsurface soil samples, including four QA/QC duplicate samples, will be analyzed for SVOCs/PAHs utilizing EPA Methods 8270: semivolatile organic compounds by gas chromatography (GC) – mass spectrometry (MS). A total of 40 subsurface soil samples, including four QA/QC duplicate samples, will be analyzed for PCBs utilizing EPA Method 8082C: PCBs by GC. Sample analyses for SVOCs, PAHs, and PCBs will be performed by Curtis and Tompkins Laboratories. Inter-laboratory QA/QC samples will be submitted to BC Laboratories for analysis. Tables 3 and 4 presents the EPA methods, analyte suite, and reporting limits for SVOCs (including PAHs) and PCBs, respectively. Sample preparation and analysis conducted by the analytical laboratories will follow QA/QC requirements specified in the Livermore Site and Site 300 QAPP (Dibley 1999, Section 2, pp. 15-25). All offsite contract analytical laboratories will use methods and procedures functionally equivalent to the methods and procedures defined in the EPA Contract Laboratory Program and the California DTSC Certified Laboratory Program. These offsite contract analytical laboratories must maintain a California Department of Health Services (DHS) Environmental Laboratory Accreditation Program certification for analytical tests for which the DHS offers certification. Analytical laboratory QA/QC procedures are described in Section 3.6.

Upon receipt, the analytical data and associated QC data will be managed by LLNL Data Management personnel and the results and QC will be validated by the LLNL QC Chemist in accordance with LLNL data management-related SOPs (Table 2).

3.2.4. Data Evaluation

Analytical data obtained for the subsurface soil samples collected in the debris burial trench area will be evaluated for SVOC, PAH, and PCB concentrations to determine the next steps to be taken.

These results will be considered as sufficient evidence that there is no risk to human health or threat to ground water associated with these constituents if:

- SVOCs, PAHs, and PCBs are not detected at concentrations above the analytical reporting limit (RL) in any subsurface soil sample.
- The samples include soil collected near metal debris encountered in the boreholes.

The investigation of the Eastern GSA Debris Burial Trenches will then be considered completed and no further action (i.e., additional soil sampling) for these constituents will be taken.

If SVOCs, PAHs, and PCBs are not detected at concentrations above the analytical RL in any subsurface soil sample, but no metal is encountered in any of the boreholes, DOE will discuss the need for additional borehole drilling and sampling with EPA.

If SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above analytical RLs and the sample results indicate the extent of contamination may not be fully defined horizontally and/or vertically, then DOE/LLNL will discuss the need for and type of additional soil sampling with the regulatory agencies.

If SVOCs, PAHs, and/or PCBs are detected at concentrations above RLs and the sample results indicate the extent of contamination in subsurface soil is defined vertically and horizontally (as defined by non-detections), then DOE/LLNL will proceed with the evaluation of the constituent concentrations detected against regulatory screening levels (i.e., EPA soil Regional Screening Levels [RSLs]).

If SVOCs, PAHs, and/or PCBs are detected at concentrations above regulatory screening levels (i.e., EPA soil RSLs) in subsurface soil samples, then DOE/LLNL will evaluate risk and potential threat to ground water associated with these constituents using site-specific data.

The specific methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies in the event that SVOCs/PAHs, and/or PCBs are detected in the subsurface soil samples.

If SVOCs/PAHs and/or PCBs are detected and are determined to pose an unacceptable risk or threat to ground water above drinking water Maximum Contaminant Levels (MCLs), then DOE/LLNL will follow the CERCLA process to propose and assess remedial alternatives, and select and implement a remedy to mitigate the risk and/or threat to ground water. For example, a Focused Feasibility Study would be prepared that proposes remedial alternatives and a remedy would be selected to address these constituents in an Amendment to the GSA Record of Decision (ROD).

3.3. Safety Procedures

All work at LLNL Site 300 is performed under the Integrated Safety Management System that was developed in accordance with the guidance provided in DOE M450.4-1, Integrated Safety Management System Manual, and is the structure used for performing work safely and protecting the environment at LLNL.

At LLNL, the Integration Work Sheet (IWS) is the primary mechanism for initiating and controlling the safe performance of work. The process establishes the scope of work, analyzes the hazards, develops and implements the hazard controls, documents the authorization and release of work, and provides for feedback and improvement. The IWS incorporates and addresses hazards associated with the specific tasks to be performed and the equipment and tools to be used as part of an activity, work location/environment, and other aspects of the work that could pose a hazard needing controls.

IWSs are prepared by experienced subject matter experts that are most familiar with the activity and tasks to be performed in concert with the LLNL Environmental Safety & Health (ES&H) Team Industrial Hygienist and/or Health Physicist and the ERD Quality Assurance Implementation Coordinator. Prior to implementation, the IWSs are reviewed and approved by the Site 300 ER Site Safety Officer, the ES&H Team members, Site 300 Management, and the Responsible and Authorizing Individuals for the work to ensure that activity-specific and location-specific hazards and appropriate controls are identified. Responsible Individuals are designated for each IWS who oversee the work and ensure that workers are appropriately trained, safety procedures are followed, and hazard controls are implemented. The controls described in the applicable IWSs shall be followed during all field work described in this work plan.

The borehole drilling and sampling at the Eastern GSA Debris Burial Trenches will be performed under the LLNL ERD IWS 11276.05 r29 for ER drilling/sampling activities at Site 300. This IWS includes controls for hazards associated with (but not limited to):

- A variety of potential mechanical hazards including moving machinery and large air compressors capable of 300 pounds per square inch (psi) associated with drilling equipment.
- Encountering underground utilities, e.g., gas lines, high-voltage, water lines, airlines, etc. and working in the vicinity of overhead power lines.
- Drilling equipment with pulleys, belts, and pinch points that personnel may come into contact with when working around the drill rig.
- Climbing drilling masts for repair or maintenance.
- Noise from drilling equipment & generators.
- Use of hand tools, lifting, working on uneven surfaces.
- Contact with contamination during drilling and/or sampling.
- Waste handling and management.
- Working in areas designated as sensitive habitat.

- Use of vehicles.
- Working in remote locations.
- Biological hazards (i.e., Valley Fever spores, snakes, spiders, ticks, etc.)
- Weather (lightning and temperature extremes [heat, cold]).

Workers performing drilling/sampling activities also receive additional training including (but not limited to):

- 40-Hour SARA/OSHA Certification, Annual Refresher training, On-the-Job training, and supervisor training (as required.)
- Personal Protective Equipment.
- Air Purifying Respirator Fit Testing.
- Hearing Conservation.
- LLNL ES&H Annual Briefing.
- Electrical Safety Awareness.
- Site 300 Safety Orientation.
- Explosives and Pressure Safety Orientation.
- Valley Fever Awareness.
- Qualifications for Fire Extinguisher Users.
- Fall Protection.
- Back Care Workshop.
- First Aid.
- Qualification for Fire Extinguisher Use.
- Radio Communications.

Contracted drill rig operators and drilling geologists received additional training from their parent company who is required to provide documentation that the workers they provide are trained and experienced in the proficient and safe use and operation of their equipment, and for the drilling and sampling procedures they will perform.

Only trained personnel associated with the drilling/sampling operations are permitted in the drilling zone around the rig/drilling locations. The LLNL ERD Drilling Coordinator/Drilling Supervisor oversees the drilling/sampling activities. The LLNL ERD Site Safety Officer or designee (Drilling Coordinator/Drilling Supervisor) and the Drilling Geologist are responsible for the enforcement of personal protective equipment and safety requirements. All personnel are authorized to pause or stop work at any time when needed to address a safety concern or issue.

Prior to commencing drilling/sampling, a kick-off meeting is held at which all participating personnel are required to read/sign the IWS and demonstrate that they are up-to-date on the required training. Daily safety tailgate meetings are also held at the beginning of each fieldwork day to review safety hazards/controls and any location-, or weather-specific hazards for the day, as well as to discuss any work or safety-related issues and worker feedback.

3.4. Contamination Control and Sampling Equipment Decontamination Procedures

Contamination control procedures, outlined in laboratory-specific IWSs will be followed to prevent contamination of facilities and personnel. To control potential contamination, auger cuttings will be placed on plastic sheeting adjacent to the borehole during drilling and sampling activities. These soil cuttings will be placed back in the borehole once all borehole sampling and surveying is complete. As discussed in Section 3.2.1, any excess soil cuttings that cannot be returned to the boreholes will be containerized and submitted to the LLNL RHWM Division for characterization and disposal.

Drilling equipment will be decontaminated after leaving each investigation area following guidance provided in ERD SOP 4.5: General Equipment Decontamination; Sampling equipment decontamination (Table 2). Drilling equipment (i.e., auger flights) and any sampling equipment will be decontaminated between each borehole following guidance provided in ERD SOP 4.5: General Equipment Decontamination; Sampling equipment decontamination (Table 2). As specified in SOP 4.5, this will be done by mechanically removing any soil on the auger flights or sampling equipment to the same plastic sheeting that will contain the drill cuttings. Once any soil has been removed, the auger flights and other large equipment will be rinsed using potable water from onsite water-supply Well 20 and small sampling equipment will be rinsed lightly using deionized water that will be contained in a drum. At the conclusion of the sampling effort, the decontamination rinse water will be sampled and analyzed for SVOCs/PAHs (EPA Method 625) and PCBs (EPA Method 8082A). If these constituents are not detected above analytical RLs, the rinse water in the drum(s) will be allowed to evaporate. If they are detected, the rinse water drum(s) will be submitted to LLNL RHWM for disposal at the appropriate facility based on the constituents detected and concentrations.

3.5. Sample Control, Sample Tracking, and Data Control

Analytical sample custody and the analytical sample custody logbooks are to be handled according to applicable SOPs (Table 2).

3.6. Quality Assurance/Quality Control

Quality assurance is a management system for ensuring that all information, data, and decisions are technically sound and properly documented. The Livermore Site and Site 300 QAPP (Dibley, 1999), and associated SOPs (Goodrich and Lorega, 2012) contains guidance for the following parameters:

- Sampling and decontamination.
- Sample custody.
- Calibration procedures and frequency.
- Analytical procedures.
- Data reduction, validation, and reporting.
- Internal quality control checks.

- Frequency, performance, and system audits.
- Specific routine procedures used to assess data precision, accuracy, and completeness.
- Corrective actions.
- QA reports to management.

Appendix B discusses QA objectives for the procedures and the data relevant to this work plan. QA considerations for procedures include field and laboratory methods. To assess data quality the precision, accuracy, representativeness, comparability, and completeness parameters are determined. Details of these procedures are presented in Appendix B.

4. Summary and Next Steps/Process

The characterization activities outlined in this Work Plan will provide data to determine if SVOCs/PAHs and/or PCBs are present in subsurface soil in the Eastern GSA debris burial trenches, and if so, if concentrations of these constituents could pose an unacceptable risk or impact ground water above MCLs. The results of these activities will be reported at a RPM meeting.

If no SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above their analytical RLs, the sampling effort and data will be presented in a Technical Memorandum that will be provided to the regulatory agencies for review and comment. Once approved, the Technical Memorandum will be included as an appendix to the Final Close Out Report for the Eastern GSA.

If SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above their analytical reporting limits, then DOE/LLNL will proceed with the evaluation of the constituent concentrations detected against regulatory screening levels (i.e., EPA soil RSLs). If SVOCs, PAHs, and/or PCBs are detected in the soil samples at concentrations above the regulatory screening levels, then DOE/LLNL will evaluate the risk and the potential impact to ground water associated with these constituents using site-specific data. The methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies. DOE/LLNL would present the results of the soil sampling and the risk and ground water threat analysis in a Characterization Summary Report. The report contents will be discussed with the regulatory agencies prior to submittal.

5. Schedule

This work plan is currently scheduled for final regulatory approval by summer of 2014. A schedule for the sampling and analysis activities will be developed and discussed with the regulators, once regulatory approval of the work plan is received. The U.S. Fish and Wildlife Service Biological Opinion requires that the soil sampling outlined in this work plan be completed by October 15, 2014. The DTSC and RWQCB agreed that their comments on the draft final version of this Work Plan have been adequately addressed on September 8, 2014 and September 17, 2014 respectively. On September 18, 2014, the U.S. EPA agreed with the DOE/LLNL approach of going forward with the sampling while continuing to finalize this Work Plan. The subsurface soil sampling outlined in this Work Plan began on September 22, 2014.

6. References

Dibley, V. (1999), Quality Assurance Project Plan, Livermore Site and Site 300 Environmental Restoration Projects, Lawrence Livermore National Laboratory, Livermore, California. March 1999 (UCRL-AR-103160 Rev. 2).

Dibley, V., J. Valett, and L. Ferry (2006), *Five-Year Review Report for the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-220827.

Dibley, V. and L. Ferry (June 2013), Close Out Report for the *Eastern General Services Area Subarea of the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-607015-DRAFT FINAL.

Ferry, R., W. Daily, L. Ferry, G. Aarons, V. Madrid, J. Valett, and Z. Demir, (2001), *Five-Year Review Report for the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-144104.

Goodrich, R., and G. Lorega (Eds.) (2012), *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)*, Lawrence Livermore National Laboratory Livermore, Calif. (UCRL-AM-109115 Rev. 14).

Rueth, L. and T. Berry (1995), *Final Feasibility Study for the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-113860.

Rueth, L., R. Ferry, L. Green-Horner, and T. DeLorenzo, (1998), *Remedial Design Document for the General Services Area Operable Unit Treatment Facilities, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-127465.

U.S. DOE (1997), *Final Record of Decision for the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-124061.

U.S. EPA (2006), *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, February 2006.

Valett, J., V. Dibley, V. Madrid and L. Ferry (2011), *Five-Year Review Report for the General Services Area Operable Unit, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, UCRL-AR-486703.

Wade, W., R. Ferry, S. Vonder Haar, and J. Copland (1991), *Remedial Investigation of the Eastern GSA Debris Pile, Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory (unpublished).

Webster-Scholten, C.P. (1994), *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300 (Chapter 14: GSA Study Area),* Lawrence Livermore National Laboratory, UCRL-AR-108131.

7. Acronyms and Abbreviations

bgs	Below ground surface
°C	Degrees Celsius
CALs	Contract Analytical Laboratories
CAP	Consolidated Audit Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	Chain of custody
COC	Contaminant of Concern
DCE	Dichloroethylene
DHS	California Department of Health Services
DMT	Data Management Team
DOE	U.S. Department of Energy
DQOs	Data Quality Objectives
DTSC	California Department of Toxic Substances Control
EPA	Environmental Protection Agency
ERD	Environmental Restoration Department
ES&H	Environmental Safety & Health
FFA	Federal Facility Agreement
Ft	Feet
GC	Gas chromatograph
GPR	Ground penetrating radar
GPS	Global Positioning System
GSA	General Services Area
HSU	Hydrostratigraphic unit
ID	Identification
in.	Inches
IWS	Integration Work Sheet
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security, Limited Liability Corporation
MCL	Maximum Contaminant Level
MDA	Minimum Detection Activity
mg/kg	Milligram per kilogram
ml	Milliliter
NELAP	National Environmental Laboratory Accreditation Program
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAHs	Polycyclic aromatic hydrocarbons
PCA	Tetrachloroethane

PCBs	Polychlorinated biphenyls
PCE	Tetrachloroethylene
Psi	Pounds per square inch
QA	Quality assurance
Qal	Quaternary alluvium
QAPP	Quality Assurance Project Plan
QC	Quality control
QSAS	Quality Systems for Analytical Services
%RCV	Percent recovery
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting limit
ROD	Record of Decision
%RPD	Relative percent difference
RPM	Remedial Project Manager
RSL	U.S. EPA Regional Screening Levels
RWQCB	Regional Water Quality Control Board-Central Valley Region
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard operating procedure
SPACT	Sample Planning and Chain-of-Custody Tracking
SSLs	Soil screening levels
SVOC	Semivolatile organic compound
SWRI	Site-Wide Remedial Investigation
TCE	Trichloroethylene
TEIMS	Taurus Environmental Information Management System
$Tnbs_1$	Tertiary Neroly Lower Blue Sandstone
VOC	Volatile organic compound
VSP	Visual Sampling Plan
μg/L	Micrograms per liter

Figures

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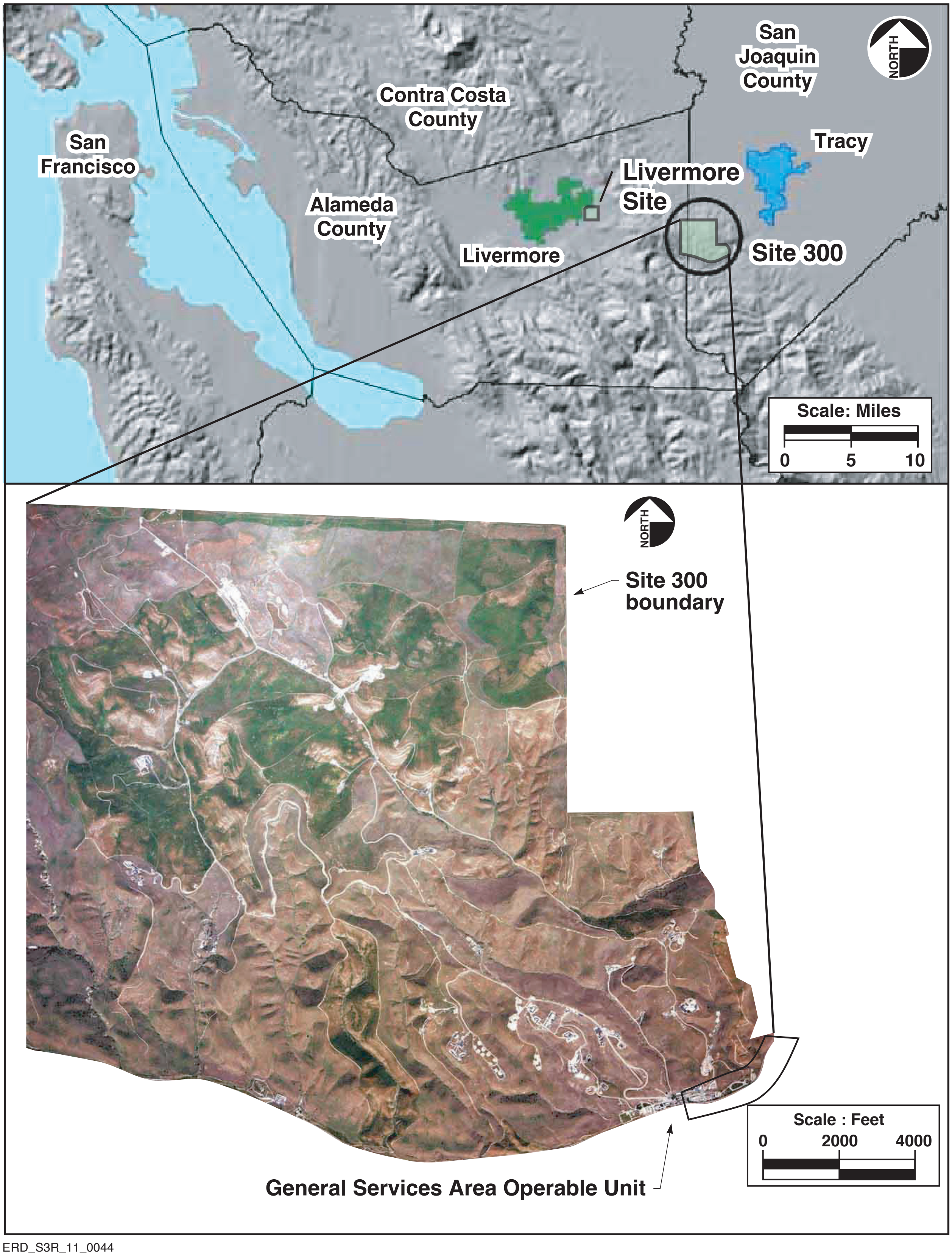

Figure 1. Location of LLNL Site 300 and the General Services Area Operable Unit.

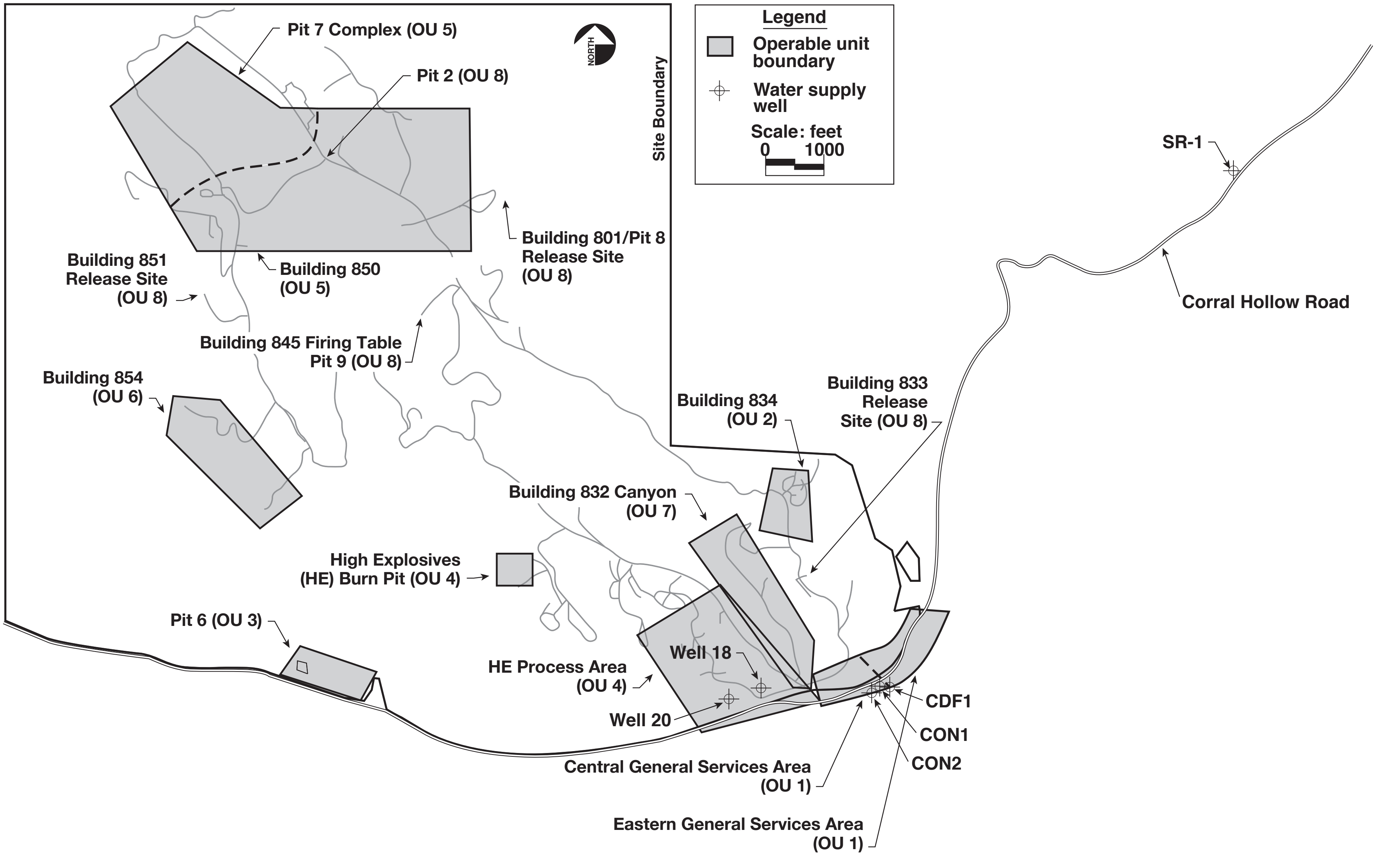

Figure 2. Map showing location of Central and Eastern General Services Area (GSA) subareas of GSA Operable unit.

Debris burial trench area (facing northwest)

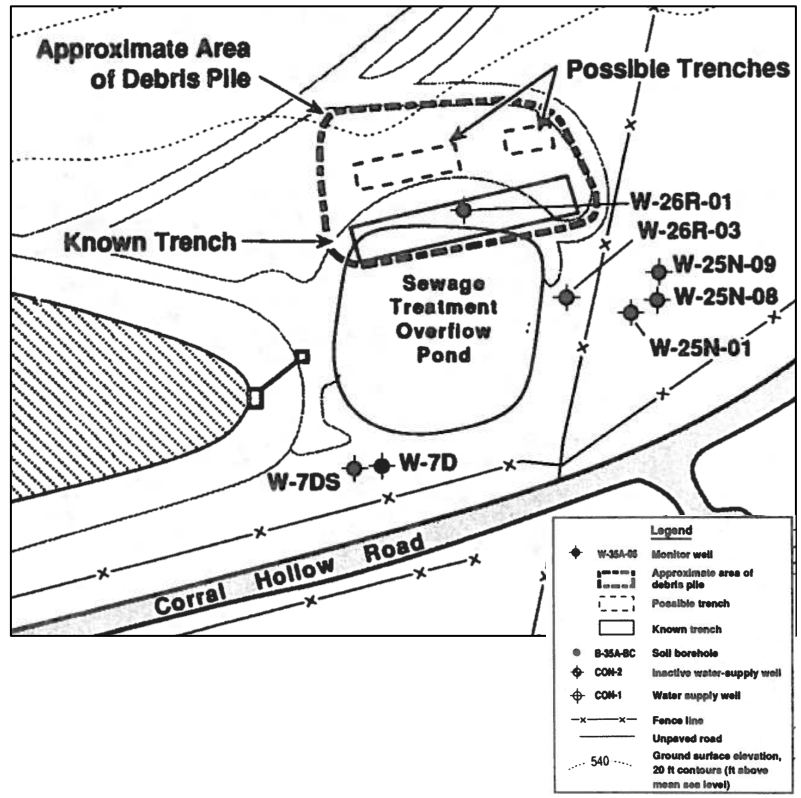

Figure 3. Location of Eastern GSA debris burial trenches.

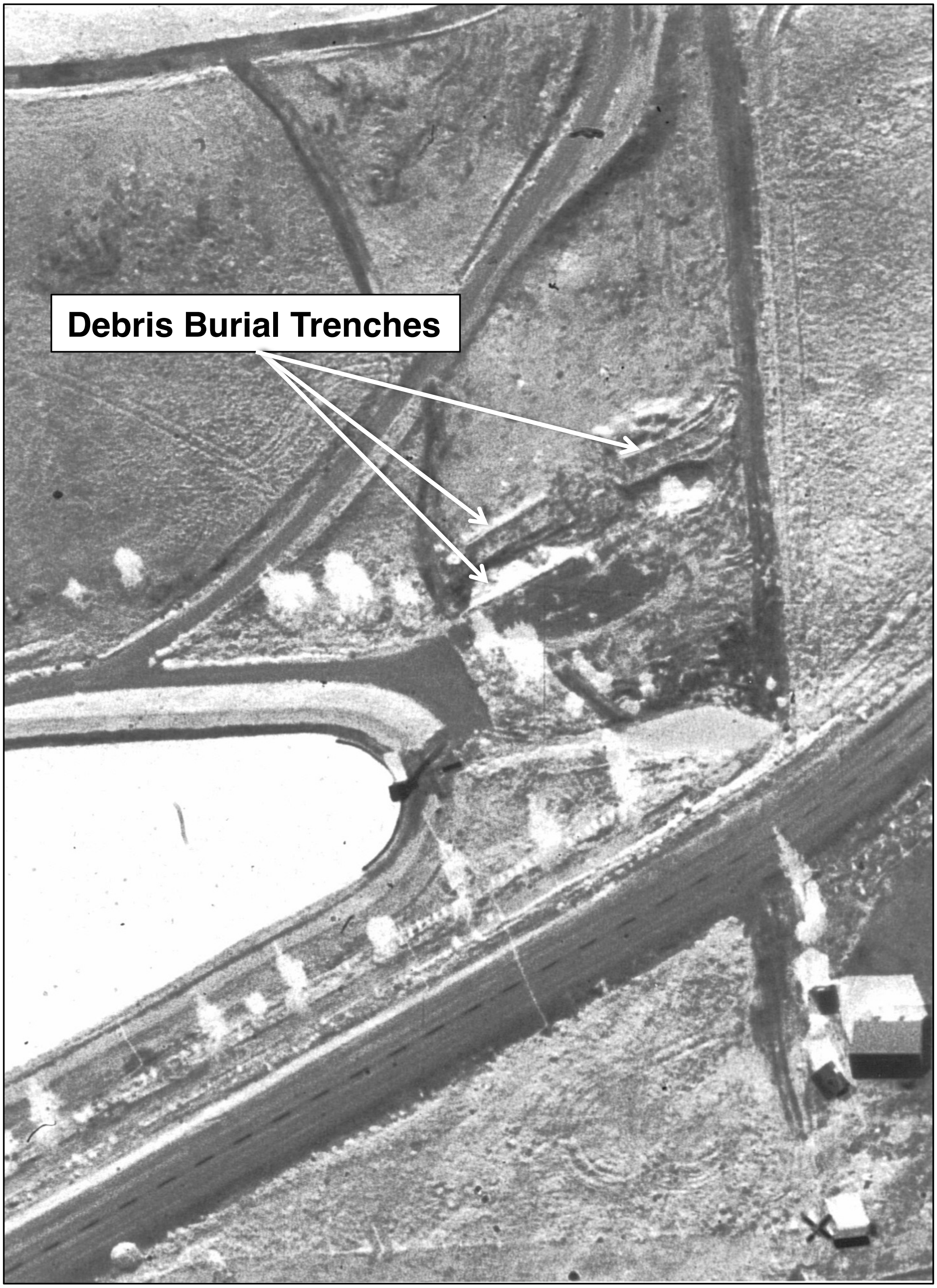

Figure 4. Aerial photograph of Eastern GSA Debris Burial Trench area (November, 1968).

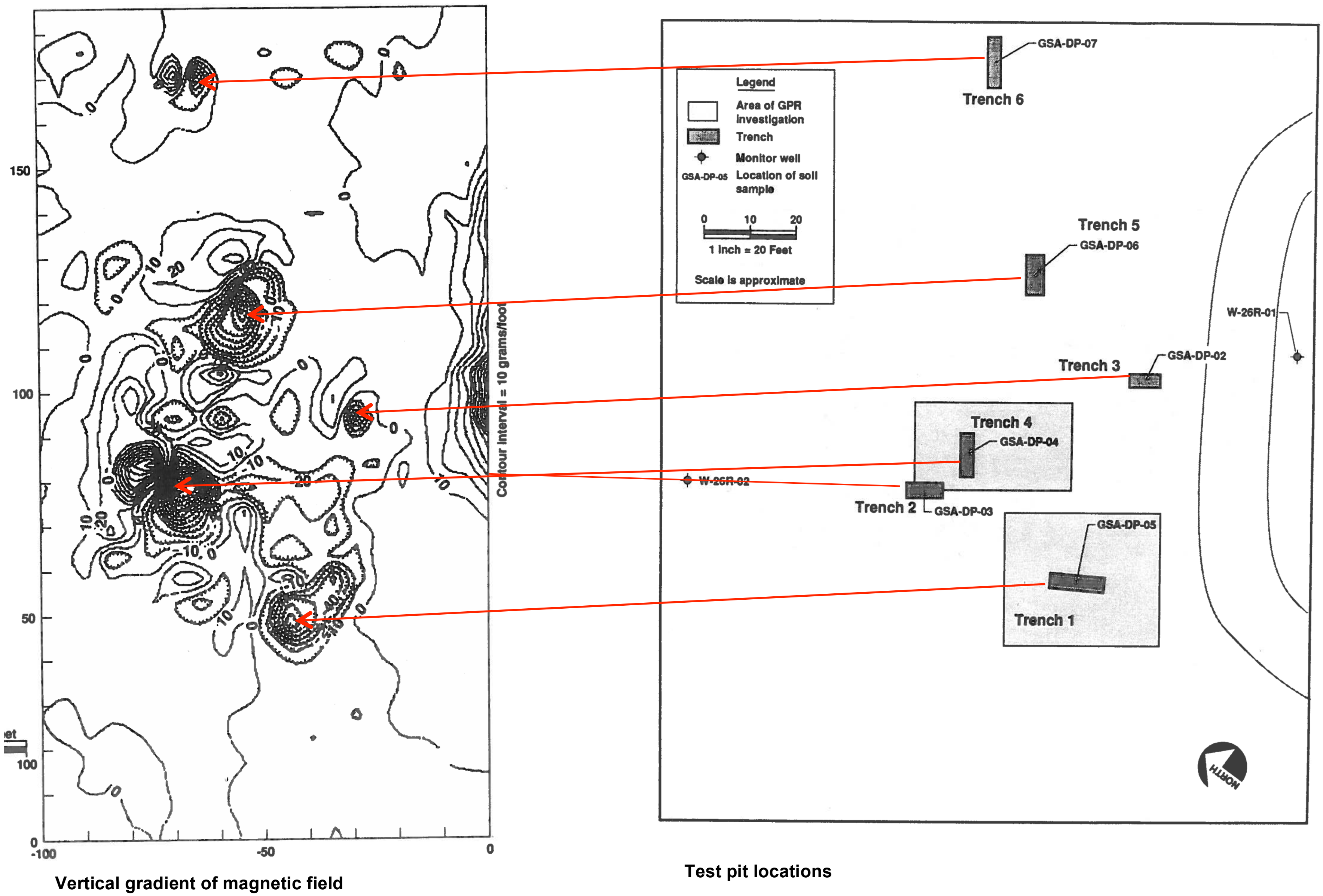

Figure 5. Location of 1990 test pits (trenches) 1-6 based on magnetic anomalies identified in magnetic/GPR surveys.

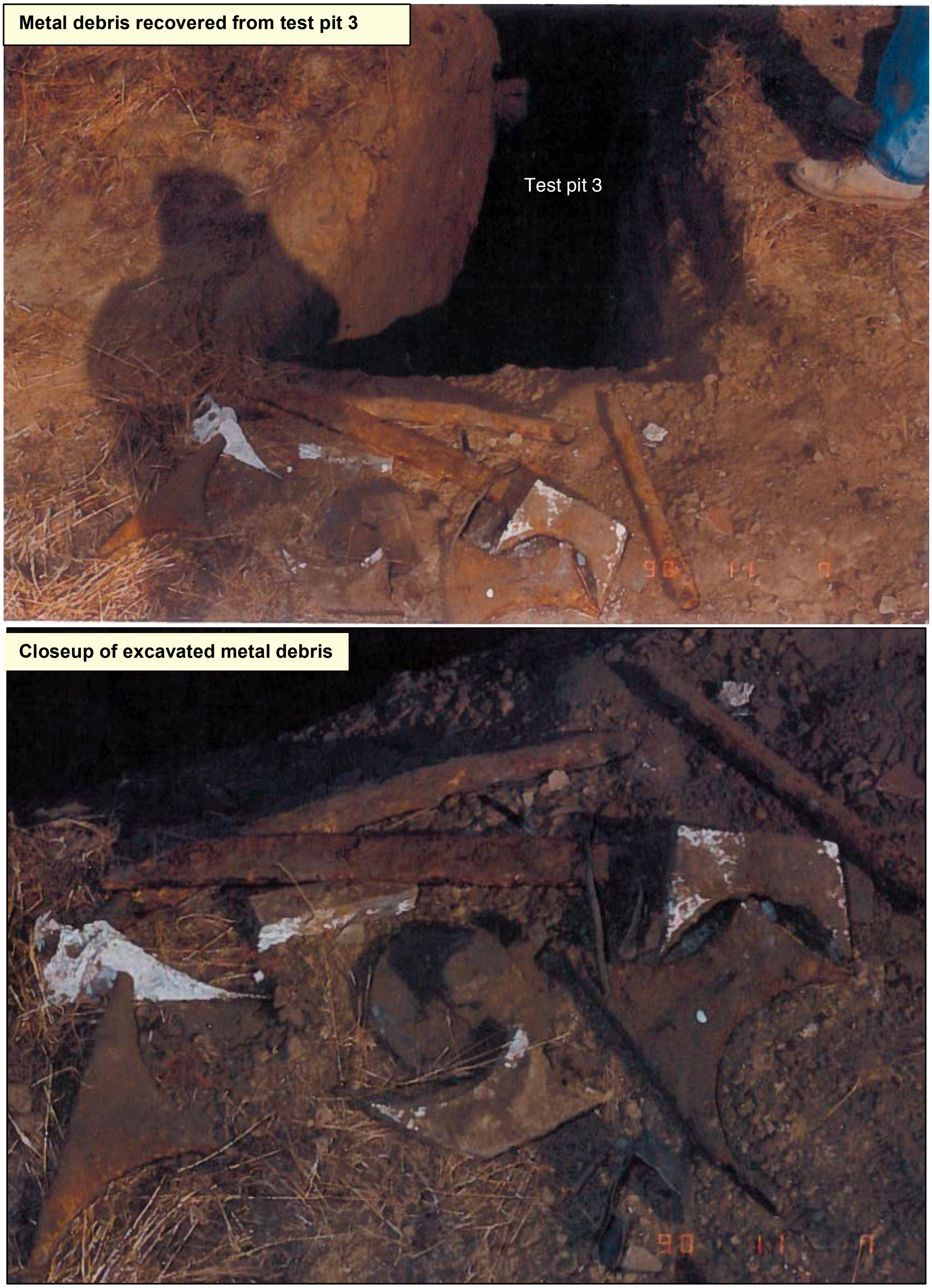

Figure 6. Metal debris excavated from test pit 3; Eastern GSA Debris Burial Trench (November, 1990).

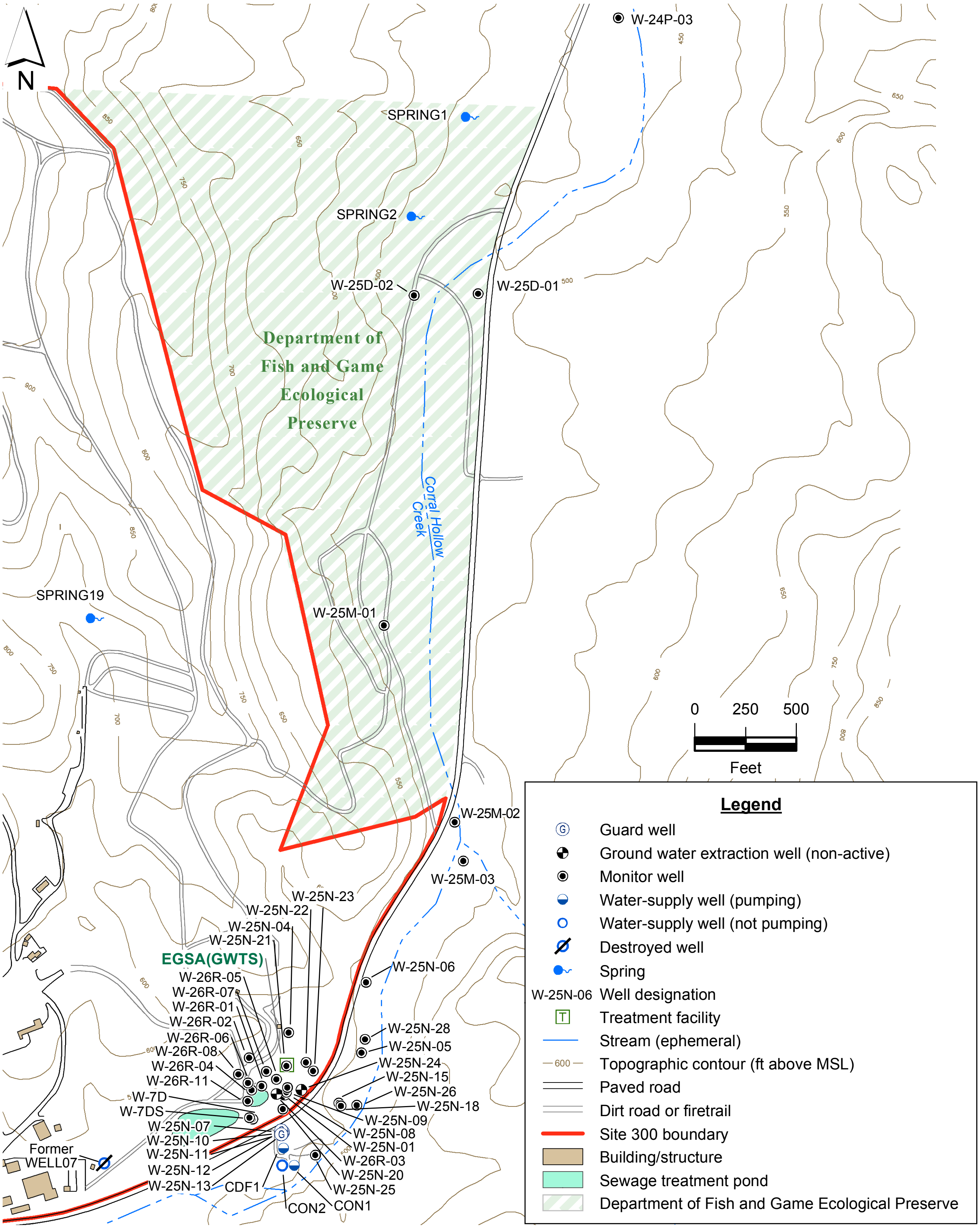

Figure 7. Locations of monitor, extraction and water-supply wells, and the former ground water extraction and treatment system in the Eastern GSA.

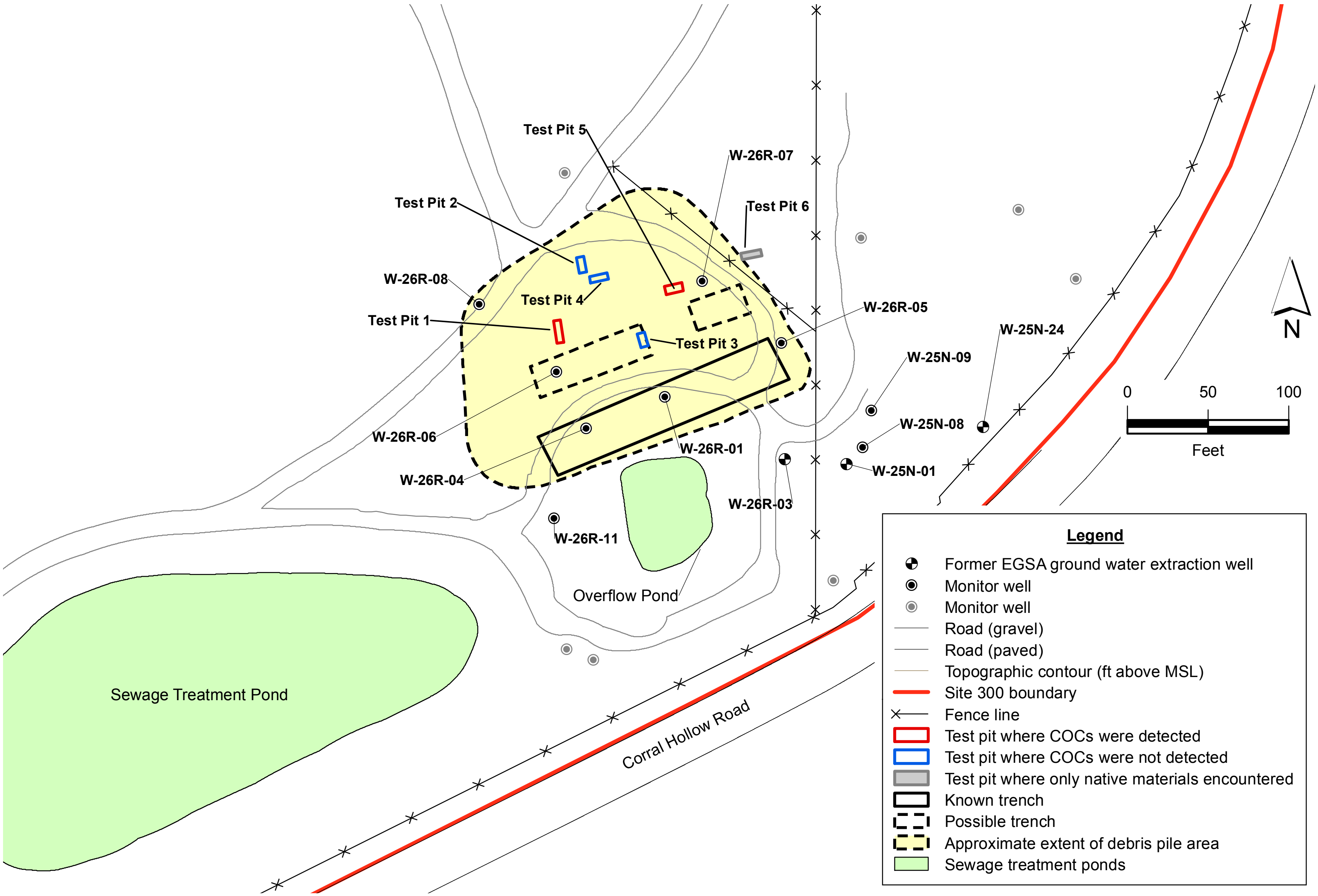

Figure 8. Eastern GSA Debris Burial Trench Study area map.

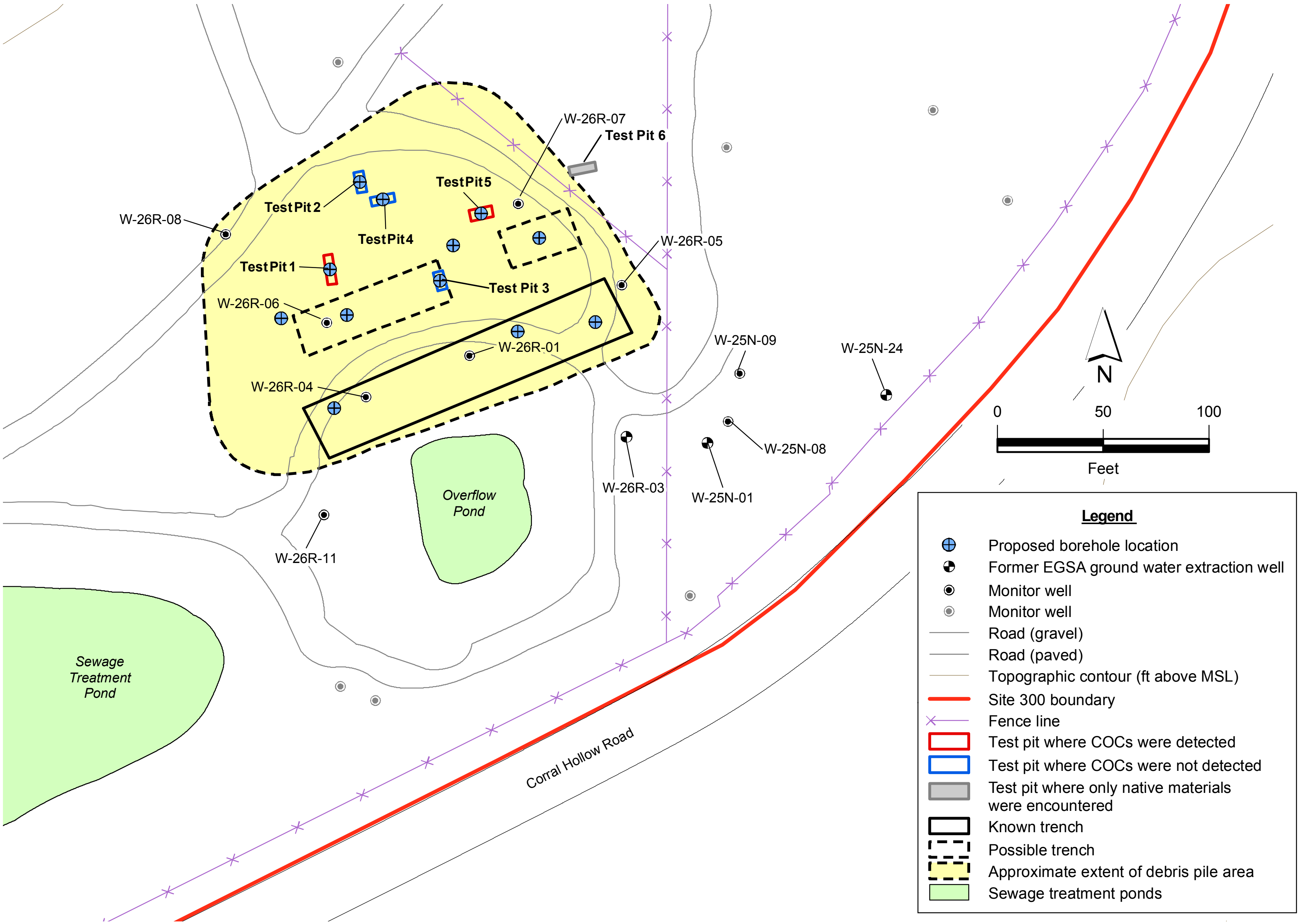

Figure 9. Eastern General Services Area Operable Unit site map showing proposed boreholes, wells, trenches, test pits and approximate area of debris pile.

Tables

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Table 1. Data Quality Objectives for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trenches.

Step 1. State the Problem.
Define the problem that necessitates the study and identify the planning/project team.

Soil samples collected the late 1980s and early 1990s in the Eastern General Services Area (GSA) debris burial trench area during the Site 300 Site-Wide Remedial Investigation (SWRI) (Webster-Scholten, 1994) were not analyzed for semi-volatile organic compounds/polycyclic aromatic hydrocarbons (SVOCs/PAHs) or polychlorinated biphenyls (PCBs).

The current U.S. Environmental Protection Agency (EPA) and California Regional Water Quality Control Board (RWQCB) Remedial Project Managers (RPMs) have suggested that the lack of analyses for SVOCs/PAHs and PCBs in subsurface soil during the remediation investigation is a data gap because:

- The EPA Guidance for conducting Remedial Investigations and Feasibility Studies for Landfills indicates that analytes should be taken from the Target Compound List and Target Analyte List, which includes SVOCs and PAHs.
- Cutting oils may have been present in the debris, and cutting oils historically may have contained PCBs.
- Although SVOCs/PAHs and PCBs have never been detected in EGSA ground water, if these constituents were associated with debris buried in the trenches, they might impact ground water in the future.

Historical information was evaluated to: (1) define the study area for the investigation of potential releases of SVOCs/PAHs and PCBs from the Eastern GSA debris burial trenches to subsurface soil, and (2) begin to develop a conceptual model (i.e., defining potential primary and secondary source areas). Historical information that was evaluated included:

- Aerial photographs.
- Interviews with personnel.
- Information presented in previous reports including the Site 300 SWRI [DOE 1994].
- Data from soil samples collected during drilling of boreholes and ground water monitor wells.
- Data and information from the 1990 test pit excavation investigation and sampling effort (Wade et al., 1991).

Historical information is summarized here, and is discussed in more detail in Section 2.3 of the Work Plan.

In the 1960s and 1970s, craft shop debris contaminated with small amounts of volatile organic compounds (VOCs) was buried in trenches located in the Eastern GSA. The Site 300 SWRI concluded that: (1) the debris in these trenches was the source of VOCs detected in Eastern GSA soil and ground water, and (2) VOCs in ground water are the only contaminants and environmental media of concern in the Eastern GSA.

As part of the SWRI investigation, six test pits were excavated in 1990 in the trench area to investigate the nature of the debris placed in the trenches, and to collect soil samples to determine the nature and extent of contamination in the debris burial trench area. As shown in Figure 5 (from Wade et al., 1991), the test pits were located to correspond with vertical magnetic gradient anomalies, rather than within trench locations.

Craft shop debris, such as scrap metal, lathe turnings, porcelain shards, electrical wire, assorted metal pipes, and glass (Figure 6) was encountered in five of the six test pits, including pits that appear to be outside the trench locations identified in an historical aerial photo. This material had been mixed with soil during placement. The magnetic/ground penetrating radar surveys indicated that drums or metal containers were not present; which was confirmed by the test pit excavations. Most VOC results from test pit soil samples were below analytical laboratory reporting limits (RLs).

Table 1. Data Quality Objectives for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trenches.

Step 1. State the Problem continued.

Define the problem that necessitates the study and identify the planning/project team.

The conceptual model assumptions for the purposes of this data gap investigation are that, if SVOCs/PAHs and PCBs are present:

- The primary source was the craft shop debris in the Eastern GSA debris burial trenches.
- The primary release mechanism was the dissolution and release of SVOCs/PAHs & PCBs associated with buried debris.
- The secondary sources are SVOCs/PAHs & PCBs that were released to and are present in subsurface soil in the debris burial trench area.

Because the purpose of this study is to fill a data gap, and SVOC/PAH and PCB contamination is, at this point, only a possibility, this conceptual model does not address secondary release mechanisms, contaminant migration, or exposure pathways and routes that would become relevant should SVOC/PAH or PCB contamination be found. Completion of a conceptual model to include these elements will be addressed in follow-up work if such contamination is found.

The planning/project team consists of Claire Holtzapple, Mark Buscheck, Zafer Demir, Valerie Dibley, Leslie Ferry, Anne Helmig, Victor Madrid, and Don MacQueen. Victor Madrid is a California Professional Geologist and Certified Hydrogeologist.

Step 2. Identify the Goal of the Study.

State how environmental data will be used in meeting objectives and solving the problem, identify study question and relevance, and alternative outcomes.

The goal of this study is to fill in the data gap. The study question is whether or not SVOCs/PAHs or PCBs are present in subsurface soil in the debris burial trench study area. The results of the analysis of subsurface soil samples collected from boreholes drilled in the debris burial trench study area will be used to determine if SVOCs/PAHs or PCBs are present in subsurface soil, resulting in the following decision options:

- If they are not present, then no further work (i.e., additional soil sampling) for these constituents will be necessary.
- If they are present, then further assessments will be necessary as described in Sections 1.3 and 3.2.4 of the work plan.

In either case, the data gap will be considered to have been filled.

Step 3. Identify Information Inputs.

Identify data & information needed to answer study questions.

SVOC/PAH and PCB analytical data for subsurface soil samples collected from boreholes in the debris burial trench study area are needed to fill the data gap.

Table 1. Data Quality Objectives for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trenches. (Continued)

Step 4. Define the Boundaries of the Study. *Specify the spatial & temporal limits, scale of inference.*
An aerial photo taken during the time the debris burial trench(es) were in use showed one larger trench and up to two other possible smaller trenches (Figure 4). However, during the 1990 test pit excavation metal debris was encountered in test pits that appear to be outside the debris burial trench locations shown in the aerial photo. The test pit locations are shown on a map in the test pit report (Wade et al., 1991) and in photos taken during test pit excavation relative to site features (i.e., roads, fence lines, sewage treatment and overflow ponds) that are still present. The aerial photo shows open trenches located north of Corral Hollow Road, immediately west of a north-south fence line, and east of the sewage treatment pond. All of these features still exist today. In addition, as described in Step 1, data from previous investigations (i.e., VOC concentrations in soil) were used to define the debris burial trench study area boundary. Therefore, there is a high level of confidence that an overall perimeter /study area for the Eastern GSA debris burial trench area can be accurately located. However, because the locations of the burial trenches and test pits within the study area were not surveyed, their locations within the study area are approximate. The study area boundaries and the approximate locations of the trenches and test pits are shown on Figure 8 of the work plan. The study area consists of an approximately 150 by 200 foot area [30,000 square feet (ft^2)], down to a depth of 15 feet (ft) below ground surface (bgs). This volume encompasses the approximate locations of the debris burial trenches and 10 ft depth of the debris burial trenches. Inferences will apply to the defined study area. No inference outside the study area will be made.
Step 5. Develop the Analytical Approach and Decision Analysis. *Define the parameters of interest, specify the type of inference, and develop the logic for drawing conclusions from findings.*
Parameters: The study question is whether or not PCBs or SVOCs are present in subsurface soil in the study area. Therefore, the parameters of interest are the SVOC/PAH and PCB concentrations in subsurface soil samples above analytical laboratory RLs. *Decision rule*: If all results are below analytical laboratory RLs, then SVOCs/PAHs and PCBs will be considered to be not present in the study area, and no further work (i.e., additional soil sampling) for these constituents will be necessary. Otherwise, if SVOCs/PAHs, and/or PCBs are detected at concentrations above the RL, then further assessments to evaluate risk to human health and threat to ground water will be conducted in coordination with the regulatory agencies (see Work Plan Section 3.2.4).
Step 6. Specify Performance or Acceptance Criteria. *Develop performance criteria for new data being collected or acceptable criteria for existing data being considered for use.*
Since the parameters of interest (Step 5) are the SVOC/PAH and PCB concentrations in the subsurface soil samples above the analytical laboratory RLs, analytical performance criteria are based on the values of the RLs.

Table 1. Data Quality Objectives for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trenches. (Continued)

Step 6. Specify Performance or Acceptance Criteria continued.

Develop performance criteria for new data being collected or acceptable criteria for existing data being considered for use.

If SVOCs/PAHs or PCBs are found to be present, then potential impacts to human health and ground water will be assessed as part of a follow-on effort (Work Plan Section 3.2.4). In order to be ready to support this potential subsequent use of the data, RLs must be below levels that could lead to an unacceptable impact to human health or ground water. For the purpose of these data quality objectives (DQOs), EPA's industrial soil Regional Screening Levels (RSLs) and MCL-based Protection of Ground Water Soil Screening Levels (SSLs) are used to indicate such levels. Therefore, RLs must be less than RSLs/SSLs, if achievable.

Standard EPA analytical methods 8270 and 8082 will be used to detect SVOCs/PAHs and PCBs contained in the EPA Target Compound/Analyte List (Tables 3 and 4). Reporting limits for all individual analytical parameters are consistent with quantitation limits in the EPA Target Compound/Analyte List.

As shown in Table 3, RLs for all individual SVOC/PAH analytical parameters in the EPA Target Compound/Analyte List are below their respective RSLs/SSLs, with the following exceptions:

- Atrazine: The RL is 0.1 mg/kg. While this RL is below the EPA industrial soil RSL of 7.5 mg/kg, it is above the MCL-based Protection of Ground Water SSL of 0.0019 mg/kg.
- Hexachlorobenzene: The RL is 0.1 mg/kg. While this RL is below the EPA industrial soil RSL of 1.1 mg/kg, it is above the MCL-based Protection of Ground Water SSL of 0.013 mg/kg.

As shown in Table 4, RLs for all individual PCB analytical parameters in the EPA Target Compound/Analyte List are below their respective RSLs/SSLs. (In Tables 3 and 4, the lower of the RSL and MCL-based Protection of Ground Water SSL are shown for individual analytical parameters for comparison with RLs.)

The performance criterion for the sampling method is that loss of SVOCs (e.g., through volatilization when the soil is disturbed) during the sample collection process must be minimized. ERD sampling SOPs meet this requirement.

Data will be accepted if they are collected and analyzed according to the specifications of this Work Plan and are validated as described in the LLNL Environmental Restoration Department's (ERD) Quality Assurance Project Plan (QAPP) (Dibley, 1999). If modifications to the collection or analysis procedures described in this Work Plan are necessary, these changes will be evaluated for their impact on resulting data usability. Additional performance or acceptance criteria are specified in Section 3.6 and Appendix A of this Work Plan.

Since the goal of the study is to determine if SVOCs/PAHs or PCBs are present, the overall performance criterion for the sampling effort is to maximize the likelihood of finding SVOCs/PAHs or PCBs if they are present.

Step 7. Develop the Plan for Obtaining Data.

Select the resource-effective sampling and analysis plan that meets the performance criteria.

Based on a discussion with EPA, DTSC, and the RWQCB at the July 22nd, 2014 RPM meeting, DOE and the regulatory agencies agreed that:

- Six boreholes would be drilled within the known debris burial trench locations as requested in regulatory comments on the draft work plan.
- Six boreholes would be drilled in the locations of the 1990 test pits where metal and/or VOC soil contamination were encountered.

The regulatory agencies concurred that this approach would result in the highest probability of detecting SVOC, PAH, and PCB contamination, if present, in subsurface soil.

Table 1. Data Quality Objectives for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trenches. (Continued)

Step 7. Develop the Plan for Obtaining Data continued.

Select the resource-effective sampling and analysis plan that meets the performance criteria.

On August 1, 2014, DOE/LLNL provided a map of the new borehole locations based on this agreed-upon approach. On August 11 and 12, 2014, the regulatory agencies concurred with the new locations that are presented in Figure 9 of this work plan.

Figure 9 presents the location of the 12 boreholes from which subsurface soil samples will be collected and analyzed. These boreholes are located within the boundaries of the debris burial trench study area shown on Figures 8 and 9.

In summary, the plan to obtain data consists of:

1. Drilling twelve boreholes in the Eastern GSA debris burial trench study area, at locations shown in Figure 9. (Budgetary constraints allow for a maximum of twelve boreholes drilled in the study area.)
2. Collecting three subsurface soil samples from each borehole at depths of 5, 10, and 15 feet, for a total of 36 samples.
3. Collecting a total of four duplicate subsurface soil samples from different randomly-selected boreholes for QA/QC purposes.
4. Analyzing the soil samples for SVOCs/PAHs and PCBs using EPA standard analytical methods 8270 and 8082C.

Samples will be collected and handled according to LLNL ERD's Standard Operating Procedures (Goodrich and Lorega, 2012). Details are provided in the Work Plan Section 3 and Appendix A.

References

Dibley, V. (1999), *Quality Assurance Project Plan, Livermore Site and Site 300 Environmental Restoration Projects*, Lawrence Livermore National Laboratory, Livermore, California. March 1999 (UCRL-AR-103160 Rev. 2).

Goodrich, R., and G. Lorega (Eds.) (2012), *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)*, Lawrence Livermore National Laboratory Livermore, Calif. (UCRL-AM-109115 Rev. 14).

U.S. EPA (2002), *Guidance for Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S, December 2002.

U.S. EPA (2006), *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, February 2006.

Wade, W., R. Ferry, S. Vonder Haar, and J. Copland (1991), *Remedial Investigation of the Eastern GSA Debris Pile, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory (unpublished).

Webster-Scholten, C.P. (1994), *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300 (Chapter 14: GSA Study Area)*, Lawrence Livermore National Laboratory, UCRL-AR-108131.

Table 2. Summary of Applicable Standard Operating Procedures (SOPs) for the Subsurface Soil Characterization Activities at the Eastern GSA Debris Burial Trench area.

SOP Number[a]	SOP Name[a]
Drilling and Subsurface Soil Sampling	
SOP-1.1	Field Borehole Logging
SOP-1.2	Borehole Sampling of Unconsolidated Sediments and Rock
SOP-1.3	Drilling
SOP-1.8	Disposal of Investigation-Derived Wastes (Drill Cuttings, Core Samples, and Drilling Mud)
SOP 1.15	Well Site Core Handling
General Field	
SOP-4.1	General Instructions for Field Personnel
SOP-4.2	Sample Control and Documentation
SOP-4.3	Sample Containers and Preservation
SOP-4.4	Guide to Packaging and Shipping of Samples
SOP-4.5	General Equipment Decontamination (Decontamination by Rinsing)
SOP-4.9	Collection of Field Quality Control (QC) Samples
SOP-4.14	Mapping with the Trimble Pathfinder Pro XR Global Positioning System
Data Validation	
SOP-4.6	Validation and Verification of Radiological and Nonradiological Data Generated by Analytical Laboratories
Data Management	
SOP-4.10	Records Management
SOP-4.18	Environmental Restoration Department (ERD) Document Control
SOP-5.1	Data Management Chain of Custody and Printed Analytical Result Receipt and Processing
SOP-5.3	Data Management Electronic Analytical Result Receipt and Processing for Sample, Analysis, and QC Data
SOP-5.4	Data Management Hand Entry of Analytical Results
SOP 5.8	Field Logbook Control
SOP-5.10	Data Management Receipt and Processing Lithology by Electronic Transfer

Notes:

[a] **Goodrich and Lorega (2012), LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures.**

Table 3. Analyte suite for semivolatile organic compounds (including polycyclic aromatic hydrocarbons) by gas chromatography–mass spectrometry by EPA Method 8270.

Analyte	CAS No.	Analytical Laboratory Reporting Limit (mg/kg)	Industrial RSL (mg/kg)	MCL-based SSL (mg/kg)
1,1-Biphenyl	92-52-4	10	210	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	0.5	180	NA
2-Chloronaphthalene	91-58-7	0.1	82000	NA
2-Chlorophenol	95-57-8	0.1	5100	NA
2-Methylnaphthalene	91-57-6	0.1	2200	NA
2-Methylphenol	95-48-7	0.1	31000	NA
2-Nitroaniline	88-74-4	0.1	6000	NA
2-Nitrophenol	88-75-5	0.1	NA	NA
2,2'-Oxybis(1-choloropropane)[a]	108-60-1	0.1	22	NA
2,3,4,6-Tetrachlorophenol	58-90-2	0.5	18000	NA
2,4-Dichlorophenol	120-83-2	0.5	1800	NA
2,4-Dimethylphenol	105-67-9	0.1	12000	NA
2,4-Dinitrophenol	51-28-5	0.5	1200	NA
2,4-Dinitrotoluene	121-14-2	0.1	5.5	NA
2,4,5-Trichlorophenol	95-95-4	0.2	62000	NA
2,4,6-Trichlorophenol	88-06-2	0.2	160	NA
2,6-Dinitrotoluene	606-20-2	0.1	1.2	NA
3-Nitroaniline	99-09-2	0.2	NA	NA
3,3'-dicholorobenzidine	91-94-1	0.2	3.8	NA
4-Bromophenyl-phenylether	101-55-3	0.1	NA	NA
4-Chloro-3-methylphenol	59-50-7	0.2	62000	NA
4-Chloroaniline	106-47-8	0.1	8.6	NA
4-Chlorophenyl-phenyl ether	7005-72-3	0.1	NA	NA
4-Methylphenol[b]	106-44-5	0.2	62000	NA
4-Nitroaniline	100-01-6	0.2	86	NA
4-Nitrophenol	100-02-7	0.2	NA	NA
4,6-Dinitro-2-methylphenol	534-52-1	0.5	49	NA
Acenaphthene	83-32-9	0.1	33000	NA
Acenaphthylene	208-96-8	0.1	NA	NA
Acetophenone	98-86-2	0.5	100000	NA
Anthracene	120-12-7	0.1	170000	NA
Atrazine	1912-24-9	0.1	7.5	0.0019
Benzaldehyde	100-52-7	10	100000	NA
Benzo(a) pyrene	50-32-8	0.1	0.21	0.24
Benzo(a)anthracene	56-55-3	0.1	2.1	NA
Benzo(b) fluoranthene	205-99-2	0.1	2.1	NA
Benzo(g,h,i) perylene	191-24-2	0.1	NA	NA
Benzo(k) fluoranthene	207-08-9	0.1	21	NA
Bis(2-chloroethoxy) methane	111-91-1	0.1	1800	NA

Table 3. Analyte suite for semivolatile organic compounds (including polycyclic aromatic hydrocarbons) by gas chromatography–mass spectrometry by EPA Method 8270. (Continued)

Analyte	CAS No.	Analytical Laboratory Reporting Limit (mg/kg)	Industrial RSL (mg/kg)	MCL-based SSL (mg/kg)
Bis(2-chloroethyl) ether	111-44-4	0.1	1	NA
Bis(2-ethylhexyl) phthalate	117-81-7	0.2	120	1.4
Butylbenzylphthalate	85-68-7	0.1	910	NA
Caprolactam	105-60-2	10	300000	NA
Carbazole	86-74-8	0.1	NA	NA
Chrysene	218-01-9	0.1	210	NA
Di-n-butylphthalate	84-74-2	0.1	62000	NA
Di-n-octylphthalate	117-84-0	0.1	6200	NA
Dibenzo(a,h) anthracene	53-70-3	0.1	0.21	NA
Dibenzofuran	132-64-9	0.1	1000	NA
Diethylphthalate	84-66-2	0.1	490000	NA
Dimethylphthalate	131-11-3	0.1	NA	NA
Fluoranthene	206-44-0	0.1	22000	NA
Fluorene	86-73-7	0.1	22000	NA
Hexachlorobenzene	118-74-1	0.1	1.1	0.013
Hexachlorobutadiene	87-68-3	0.1	22	NA
Hexachlorocyclopentadiene	77-47-4	0.1	3700	0.16
Hexachloroethane	67-72-1	0.1	43	NA
Indeno(1,2,3,-cd) pyrene	193-39-5	0.1	2.1	NA
Isophorone	78-59-1	0.1	1800	NA
N-Nitroso-di-n propylamine	621-64-7	0.1	0.25	NA
N-Nitrosodiphenylamine	86-30-6	0.1	350	NA
Naphthalene	91-20-3	0.1	18	NA
Nitrobenzene	98-95-3	0.1	24	NA
Pentachlorophenol	87-86-5	0.002	2.7	0.01
Phenanthrene	85-01-8	0.1	NA	NA
Phenol	108-95-2	0.1	180000	NA
Pyrene	129-00-0	0.1	17000	NA

Notes:

[a] **2-2'-Oxybis(1-chlropropane)ether exists in the E8270 suite as bis(2-chloroisopropyl)ether.**

[b] **4-Methylphenol exists in the E8270 suite as m- and p- Cresol.**

CAS No. = Chemical Abstracts Service Number.
EPA = Environmental Protection Agency.
MCL = Maximum Contaminant Level.
mg/kg = Milligrams per kilogram.
NA = Not Applicable.
RSL = EPA industrial soil Regional Screening Level.
SSL = EPA MCL-Based Protection of Ground water Soil Screening Level.

Table 4. Analyte suite for polychlorinated biphenyls (PCBs) by gas chromatography by EPA Method 8082C.

Analyte	CAS No.	Analytical Laboratory Reporting Limit (mg/kg)	Industrial RSL (mg/kg)	MCL-based SSL (mg/kg)
Aroclor 1016	12674-11-2	0.005	21	NA
Aroclor 1221	11104-28-2	0.005	0.54	NA
Aroclor 1232	11141-16-5	0.005	0.54	NA
Aroclor 1242	53469-21-9	0.005	0.74	NA
Aroclor 1248	12672-29-6	0.005	0.74	NA
Aroclor 1254	11097-69-1	0.005	0.74	NA
Aroclor 1260	11096-82-5	0.005	0.74	NA

Notes:

CAS No. = Chemical Abstracts Service Number.

EPA = Environmental Protection Agency.

MCL = Maximum Contaminant Level.

Mg/kg = Milligrams per kilogram.

NA = Not Applicable.

RSL = EPA industrial soil Regional Screening Level.

SSL = EPA MCL-Based Protection of Ground water Soil Screening Level.

Appendix A

Sample Control and Documentation

Appendix A

A-1. Sample Control and Documentation

A-1.1. Field Logbooks

A complete record of all samples and sampling events will be maintained by making entries into field logbook(s). Field logbooks are bound volumes with consecutively numbered pages. The Data Management Team (DMT) assigns each logbook a unique code and issues the logbooks upon request. A list of issued logbooks and their locations is maintained by the DMT. Logbooks are returned to the DMT at project completion.

The Environmental Restoration Department (ERD) Standard Operating Procedure (SOP) 4.2 "Sample Control and Documentation" describes how entries in the sampling field logbooks reflect the sampling event as accurately as possible and includes the following information:

- Date and time of sampling.
- Sample identification (ID) code.
- Method of sample collection, including preservation techniques, size or volume, description of the matrix of the sample, and any deviations or anomalies noted.
- Requested analyses and analytical laboratory performing the analyses.
- Results of associated field measurements.
- Calibration information pertaining to field instruments used for the sampling event.
- ID of field personnel performing the work.
- ID of field equipment (model number, serial number).
- Special notes of other activities in the area which may have an impact on analytical results.

Specific field data collection forms might be used during sampling activities. Each data collection form used during sampling becomes a controlled document. The document control number is derived from the logbook code and the logbook page number that was used to document that sampling event and is recorded on specific field forms including chain-of-custody forms.

A-1.2. Chain-of-Custody (CoC) Records

As stated in Draft ERD SOP 4.2: Sample Control and Documentation, the primary objective of using CoC documents is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and receipt of analytical data.

A-1.2.1. Issuance and Archival of CoC Records

- Blank CoC forms are obtained from DMT.
- Electronic COCs are produced from information in the Sampling Plan generated from the Sample Planning and Chain-of-Custody Tracking (SPACT) application in the Taurus Environmental Information Management System (TEIMS).

- Completed CoC records are archived by DMT.

A-1.2.2. Required Documentation

Each CoC document will be completed using waterproof ink and contain the following information:

- Document control number.
- Sample matrix. Sample matrix codes are listed on the Sampling Plan or in the TEIMS by opening the "Data Team" page, then using the "QBF" link to access the "SAMPMATRIX" Table.
- Name of sampler and employer.
- Requested analysis code.
- Number and type of container(s).
- Sample ID and sample date and time.
- Area from which the sample originated.
- Name of the analytical laboratory where the samples are to be sent as designated by the Sampling Plan.
- Requester name: This is the organization for which the samples are being collected.
- Additional information/instructions or remarks. The remarks section should also indicate whether field filtration and/or preservation has been performed, or if it is required upon receipt at the lab.

A-1.3. Sample Identification Labels

Detailed instructions are found in ERD SOP 4.2 "Sample Control and Documentation". ID labels are to be used when tagging or labeling sample containers. The sampling personnel may fill out sample container labels after collecting samples or prior to collecting samples at each location. Waterproof ink will be used on the label.

A-1.3.1. Issuance and Archival

Sample labels may be obtained from the analytical laboratory where the samples are to be sent for analysis. The field personnel will have an adequate stock of labels on hand at all times. Labels are not archived and are destroyed with sample disposal at the laboratory.

A-1.3.2. Required Documentation

The Sample ID Label will include the following information:

- Sample ID. The sample ID can be composed of various factors such as location, sample type, etc. If a new location is to be sampled, the DMT will approve all new sample IDs.
- Project name.
- Sample date. The date when the sample was collected.
- Sample time. Time is recorded according to the 24-hour clock (e.g., 1:00 a.m. = 0100 hour, 3:00 p.m. = 1500 hours).
- Samplers' initials. The initials of personnel conducting the sampling.
- Preservation method. The nature, concentrations and volume of any preservative added to the sample should be indicated.

- Comments. Any additional information such as hold times or special turnaround times should be provided in the comments section.
- Requested analysis. The type of analysis to be performed on the sample.

Sample identification methodology is described in SOP 1.1 “Field Borehole Logging”, Section 6.4.35, Sample Identification (ID). Included in the ID is the depth at the top of the sampling interval, which is given in feet and tenths of feet.

A-1.4. Records Management

ERD SOP 4.10 “Records Management” applies to recorded information, in any format, that is created, received, or needed to document ERD work activities. The procedure describes the identification, creation, maintenance, retention, and disposition of records created or received within the ERD and will be followed throughout the course of this Work Plan.

A-2. Sample Container and Preservation

Table A-1 summarizes the container types, volume and holding times. The samples will be collected as specified in this Work Plan. Samples for EPA 8270 and EPA 8082C shall be refrigerated and analyzed as soon as possible.

Samples requiring refrigeration at 4 degrees Celsius (4°C) will be protected from getting wet. Samples will be immediately placed in an ice chest containing either Blue Ice packs (in air-tight plastic bags), or bagged or loose ice cubes. A temperature blank will always be included in the ice chests so that the laboratory can check the temperature of the cooler at the time of sample receipt. If samples are not submitted to the laboratory daily, ice chests will be checked periodically, and thawed ice replaced. Sample preservation methods will be noted as appropriate in the sampling logbook, on the sample label, and on the CoC document.

A-3. Shipping

All samples will be shipped off site according to the ERD SOP 4.4 “Guide to Packaging and Shipping of Samples”.

Properly identified sample containers will be placed inside Ziploc®-type storage bags, sealed, and then placed in picnic-cooler-type containers. Samples to be shipped will be packed with sufficient incombustible, absorbent cushioning material to minimize the possibility of sample container breakage. Samples that require refrigeration during shipping should be packed with a sufficient number of Blue Ice packs to keep the samples preserved. Temperature blanks will accompany all samples that require temperature preservation (4°C). They consist of a 250-milliliter (ml) poly container or equivalent filled with water. It will be noted in the Remarks section of the CoC that a temperature blank has been included in the sample shipment. The receiving laboratory will measure these blanks and record the temperature on their sample receipt log.

Table A-1. Sample Container Types, Volume, and Holding Times.

Requested Analysis	Description	Sample Type	Required Volume	Container Type	Preservation Method	Hold Time
EPA 8270	SVOCs	Soil	8 ounces	Glass wide-mouth or brass/steel tube with Teflon coated lids.	Cool, 4 ºC	14 days before extraction/ 40 days after
EPA 8082C	PCBs	Soil	8 ounces	Glass wide-mouth or brass/steel tube with Teflon coated lids.	Cool, 4 ºC	14 days before extraction/ 40 days after

Notes:

ºC = Degrees Celsius.

PCBs = Polychlorinated biphenyls.

SVOC = Semivolative organic compounds.

Appendix B

Quality Assurance/Quality Control

Appendix B

B-1. Quality Assurance/Quality Control

B-1.1. Quality Assurance Chain-of-Custody (CoC) Practices

For each sample collected in the field, sampling personnel will follow the practices described in Appendix A, including the use of field logbooks, CoC procedures and documentation, and a standard identification label to accompany each sample at all times. The CoC form will accompany the samples through the sampling and analysis process. When samples change custody, the relinquishing and the receiving parties sign the CoC document.

B-1.2. Quality Assurance Performance Criteria

All sampling and analysis activities will be performed in accordance with the quality assurance (QA)/quality control (QC) practices described in this Work Plan and related procedures. Contract Analytical Laboratories (CALs) selected to perform analytical tests will possess a National Environmental Laboratory Accreditation Program (NELAP) certification for the state of California and participate in pre-award and annual United States (U.S.) Department of Energy (DOE) Consolidated Audit Program (CAP) audits. NELAP requirements do not fully encompass DOE requirements. In cases, where DOE-specific requirements differ from NELAP requirements, DOE requirements will supersede and shall be met by the CALs. All analytical laboratories, including onsite laboratories, must use methods and procedures functionally equivalent to the methods and procedures used the EPA Contract Laboratory Program and the California Department of Toxic Substances Control (DTSC) Certified Laboratory Program.

B-1.3. Quality Assurance /Quality Control Practices

The QA/QC practices to be followed during the execution of this plan are summarized in this section. Adherence to these practices will produce data capable of withstanding scientific and legal scrutiny.

B-1.3.1. Field QA/QC

Field QA/QC is ensured by following uniform procedures for sample collection, handling, CoC, and shipping, and by evaluating QC samples collected in the field. QC samples shall be collected and identified in accordance with SOP 4.9 "Collection of Field QC Samples". Field samples used to assess QA/QC for this work plan includes:

- Trip blanks. Trip blanks are provided by the CAL and will be submitted with each CoC.
- Rinsates (equipment blanks). Equipment blanks are analyzed to determine the effectiveness of the decontamination process and will be collected prior to inserting equipment downhole in a new investigative area.
- Field Blanks. A field blank is poured at the sampling location to identify contamination that may occur during the sample collection process.
- Collocated Samples. One collocated sample per 10 samples will be randomly collected. The 10 will be divided into 5% interlaboratory and 5% intralaboratory collocated

samples. When collocated samples are collected, processed, and analyzed by the same organization, they provide intra-laboratory precision information for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation and analysis. When collected, processed, and analyzed by different organizations, these QC checks provide inter-laboratory precision information for the entire measurement system. These field QC samples are required and their purpose defined in the Environmental Restoration Department (ERD) Quality Assurance Project Plan (QAPP).

B-1.3.2. Laboratory QA/QC Practices

The Quality Systems for Analytical Services (QSAS) establishes a single, integrated QA program for providers of analytical laboratories supporting the U.S. DOE operations. The QSAS provides specific technical requirements and clarification for implementation of DOE requirements and is based on EPA's NELAP. It also incorporates EPA's Performance Approach. The QSAS is incorporated into contract vehicles or agreements and is the basis for qualification of laboratories providing services to DOE. This section summarizes laboratory practices that ensure analytical QA/QC.

B-1.3.2.1. General Laboratory Controls

In addition to instrument calibration and the analysis of QC samples, the CAL that performs the analyses must implement the following analytical controls:

- Reagents and solvents will have certified compositions.
- Reagent storage environment and duration will meet the manufacturers' guidelines.
- Laboratory equipment will be calibrated/standardized following the referenced procedures for the methods used and shall be documented.
- Volumetric measurements will be made with certified glassware.
- Data reduction computations will be independently checked.
- Qualified personnel will perform laboratory analyses using approved methods.
- QA/QC requirements and guidelines specified in the selected analytical methods will be followed.

These requirements are standard in a certified laboratory and will be verified during the laboratory inspection and validation process.

B-1.3.2.2. Laboratory QA/QC

A summary of QC sample results shall be provided for each sample and shall include the following:

- Method blank results and reporting limits, matrix units, batch number, date/time of analysis, instrument identification (ID) number, analyst ID, and method code.
- Surrogate or tracer yield recoveries, if applicable.
- Sample duplicate results, and relative percent difference (%RPD), if applicable.
- Matrix spike, matrix spike duplicate recoveries and %RPDs, batch number, date/time of analysis, instrument ID number, analyst ID, matrix, method code, and sample result when indicated by the method.

- Laboratory control sample (recoveries, batch number, date/time of analysis, instrument ID, analyst ID, matrix, and method code.
- QC control limits for laboratory control samples, matrix spike/matrix spike duplicates, surrogate, and tracer yield recoveries, and %RPDs.

In addition, the CAL shall provide upon request all supporting documentation used to generate reported results, including, but not limited to:

- Initial instrument calibration data.
- Continuing calibration data.
- Retention time window determinations.
- Method detection limit determinations.
- Gas chromatography/mass spectrophometry (GC/MS) tune data.
- Laboratory QC control charts.

The following minimum corrective action (provided in the Statement of Work for each laboratory) is required to be taken by the laboratory when the QA/QC fails.

The Subcontractor shall perform at a minimum the QC analyses listed in Table B-1, as well as all other required and suggested QC sample analyses specified by the EPA Methodology.

When field QA/QC fails, as determined during the ERD data validation process, the course of action taken is decided at that time and may include, requesting a re-analysis, re-sampling, or appropriately qualifying the data in accordance with SOP 4.6: Validation and Verification of Radiological and Nonradiological Data Generated by Analytical Laboratories.

Analytical laboratories are also required to follow any additional QC steps required by the analytical method in the event of a QC failure.

All sampling will be conducted in accordance with the Livermore Site and Site 300 QAPP (Dibley 1999). Sample preparation and analysis conducted by the analytical laboratories will follow QA requirements specified in the Livermore Site and Site 300 QAPP (Dibley 1999). All offsite contract analytical laboratories shall use methods and procedures functionally equivalent to the methods and procedures defined in the EPA Contract Laboratory Program and the California DTSC Certified Laboratory Program. Offsite contract analytical laboratories must maintain a California Department of Health Services (DHS) Environmental Laboratory Accreditation Program certification for analytical tests for which the DHS offers certification.

B-1.4. Precision, Accuracy, Representativeness, Comparability, and Completeness

Analytical data will be evaluated according to the precision, accuracy, representativeness, comparability, and completeness parameters to have a level of assurance of the quality of the measurement data. These parameters are necessary when considering the usefulness of a set of data for interpretation. The definitions provided are established in the approved ERD QAPP.

B-1.4.1. Precision

Precision is determined by the degree of agreement between duplicate analyses of the same parameter in a given sample. It is an indicator of how well a laboratory can reproduce its work under a given set of conditions. Precision is expressed as %RPD and is determined by the laboratory by the analysis of matrix spike duplicates, sample duplicates, or laboratory control samples duplicates. The %RPD is compared to set control limits to determine acceptability. The ERD also assesses precision by the analysis of intralaboratory and interlaboratory collocated samples.

Field audits, and checklists will be performed on a routine basis. These audits will document the use (or nonuse) of uniform sampling methods and of handling and shipping procedures.

B-1.4.2. Accuracy

The analytical laboratories analyze QC samples to assess precision and accuracy. Accuracy is defined by the degree of agreement between measured value and true or known value. It is a measure of the bias in the measurement system. The laboratories assess accuracy, expressed as percent recovery (%RCV), by the analysis of matrix spikes and laboratory control samples. The %RCV is compared to set control limits to determine acceptability.

B-1.4.3. Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition. Representativeness is a qualitative term that determines whether in situ and other measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied. ERD uses sampling techniques and EPA prescribed sample preservation to ensure that the samples are representative of the media of interest.

B-1.4.4. Comparability

Comparability is the measure of the confidence with which one data set or method can be compared to another. Standard techniques are used to collect and analyze representative samples to ensure comparable results.

B-1.4.5. Completeness

The ERD Annual QA Report summarizes completeness by determining the completeness of the data set in terms of the number of valid results obtained for the number of analyses planned. The ERD completeness objective is 90%.

B-1.5. Data Review, Validation and Verification

Data will be reviewed by the QC Chemist upon receipt from the analytical laboratory. During this review, the chemist will verify and validate the data in accordance with the ERD QAPP and ERD SOP 4.6 “Validation and Verification of Radiological and Nonradiological Data Generated by Analytical Laboratories”.

Table B-1. Minimum Corrective Requirements.

QC Sample Type	QC Failure Corrective Action
Organic Analysis	
Method Blanks	**Follow method specified actions if analytes are detected in the method blank greater than the calculated MDL.**
Matrix Spikes	**If percent recovery is outside of control limits, perform method specific corrective actions.**
Matrix Spike Duplicate	**If relative percent difference is outside of control limits perform, method specific corrective actions.**
Laboratory Control Samples	**If percent recovery is outside control limits, reanalyze sample batch for the analytes in question.**
Surrogates	**If percent recovery is less than the lower acceptance limit, reanalyze sample.**
Trip Blanks, Field Blanks	**If analytes detected in associated samples, analyze all associated trip and field blanks.**
Inorganic Analysis	
Method Blanks	**Analyte detections in the method blank and instrument blank are unacceptable. If analytes are detected in the blank and in the samples, re-digest/reanalyze samples or, upon approval from the LLNL project managers, implement method specified actions.**
Matrix Spikes	**If percent recovery is less than 30, perform a post-digestion spike LLNL samples to check for matrix interferences.**
Matrix Spike Duplicate	**If relative percent difference is outside of control limits perform method specific corrective actions.**
Laboratory Control Samples	**If percent recovery is outside control limits, reanalyze sample batch.**
Radiological Analysis	
Method Blanks	**Follow method specified actions if analytes are detected in the method blank above the Minimum Detection Activity (MDA).**
Matrix Spikes	**If percent recovery is outside of control limits, perform method specific corrective actions.**
Matrix Spike Duplicate	**If relative percent difference is outside of control limits perform, method specific corrective actions.**
Laboratory Control Samples	**If percent recovery is outside control limits, reanalyze sample batch.**
Tracer Yields	**If percent recovery is less than the lower acceptance limit, reanalyze sample batch.**

Appendix C

Responses to Regulatory Comments on the Draft and Draft Final Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches

Appendix C

C-1. Responses to Regulatory Comments on the Draft Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches

California Department of Toxic Substances Control (DTSC) Comments

1. Section 1.4, Data Quality Objectives - Please indicate how one can view a copy of the approved QAPP.

Response: **The Quality Assurance Project Plan (QAPP) is part of the Administrative Record and a copy can be located on the LLNL Environmental Restoration Department (ERD) Library website: www-erd.llnl.gov/library/index.html. Please note that the QAPP is currently in the process of being updated.**

2. Section 2.3, Previous Investigation/Feasibility Study - Please delete discussions on human and ecological risk assessment. This section should focus on discussing previous remedial investigations and analytical results only. Additionally, delete the last three paragraphs; they provide conclusions which are irrelevant here.

Response: **Section 2.3 discusses the results of previous remedial investigations conducted for the Eastern GSA. The risk assessments and results are part of a remedial investigation, therefore this discussion was retained. The last three paragraphs of Section 2.3 discuss: (1) information supporting the remedial investigation results, (2) results of the ecological baseline risk assessment, and (3) the feasibility study, which are relevant to the discussion of previous remedial investigations and feasibility study that are the topic of this section. Therefore, these paragraphs were retained**.

3. Section 3.1, Data Quality Objectives Needs, First Paragraph, Last Sentence – Close parenthesis.

Response: **The parenthesis at the end of the last sentence in the first paragraph of Section 3.1 was closed.**

4. Section 3.2.3, Laboratory Analysis - Please provide the name of the laboratory that will perform the analyses.

Response: **Soil samples will be analyzed for semivolatile organic compounds (SVOCs) and polycyclic aromatic hydrocarbons (PAHs) (EPA 8270), and polychlorinated biphenyls (PCBs) (EPA 8082C) by Curtis and Tompkins Laboratories. Inter-laboratory quality assurance/quality control (QA/QC) samples will be submitted to BC Laboratories for analysis. The text in Section 3.2.3 revised to include the names of the laboratories that will perform the soil analyses.**

5. Section 3.2.4, Data Evaluation - Please discuss that additional soil sampling will be performed if the horizontal and vertical extent of contamination has not been determined.

Response: **As discussed at the July 22nd LLNL Site 300 Remedial Project Manager's (RPM) meeting, the following process would be followed:**

- **If no SVOCs, PAHs, or PCBs are detected in the subsurface soil samples, then no further sampling would be necessary.**
- **If SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above analytical reporting limits (RLs) and the sample results indicate the extent of contamination may not be fully defined vertically and/or horizontally, then the Department of Energy (DOE)/LLNL will discuss the need for and type of additional sampling with the regulatory agencies.**
- **If SVOCs, PAHs, and/or PCBs are detected at concentrations above RLs and the sample results indicate the extent of contamination in subsurface soil is defined vertically and horizontally (as defined by non-detections), then DOE/LLNL will proceed with the evaluation of the constituent concentrations detected against regulatory screening levels (i.e., EPA soil Regional Screening Levels [RSLs]).**
- **If SVOCs, PAHs, and/or PCBs are detected at concentrations above regulatory screening levels (i.e., soil RSLs) in subsurface soil samples, then DOE/LLNL will evaluate risk and potential threat to ground water associated with these constituents using site-specific data.**

The specific methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies in the event that SVOCs, PAHs, and/or PCBs are detected in the subsurface soil samples.

Text has been added to Section 3.2.4 (Data Evaluation) that discusses the process outlined above.

6. Section 4, Summary and Next Step/Process - In order to complete the site characterization aspect of the Eastern GSA OU, please submit to the regulatory agencies for review and approval a Characterization Report documenting the results of the site characterization effort just performed.

Response: **As discussed at the July 22nd LLNL Site 300 RPM meeting, the process for reporting the results of the Eastern GSA debris burial trench soil sampling is as follows:**

- **The results of these activities will be reported at a RPM meeting.**
- **If no SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above their analytical RLs, the sampling effort and data will be presented in a Technical Memorandum that will be attached as an appendix in the Final Closeout Report for the Eastern GSA.**
- **If SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above their analytical reporting limits, then DOE/LLNL will proceed with the evaluation of the constituent concentrations detected against regulatory**

screening levels (i.e., EPA soil RSLs). If SVOCs, PAHs, and/or PCBs are detected in the soil samples at concentrations above the regulatory screening levels, then DOE/LLNL will evaluate the risk and the potential impact to ground water associated with these constituents using site-specific data. The methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies. DOE/LLNL would present the results of the soil sampling and the risk and ground water threat analysis in a Characterization Summary Report. The report contents will be discussed with the regulatory agencies prior to submittal.

Section 4 was modified to include this information.

DTSC Geological Services Unit's comments:

GENERAL COMMENT ANO RECOMMENDATION

1. The GSU agrees with the means and methods presented in the Work Plan to help determine if SVOCs/PAHs and PCBs are present in subsurface soil in the Eastern GSA debris burial trenches.

Recommendation: The GSU recommends approval of the Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches, once the following specific comment is addressed. .

SPECIFIC COMMENT AND RECOMMENDATION

1. The GSU understands the proposed borehole locations shown on Figure 9 were determined using simple random sampling with the adaptive fill option as implemented in Visual Sample Plan (VSP) software. However, we note that none of those randomly selected locations were located within the easternmost debris burial trench identified in Figure 4.

Recommendation: Please consider moving at least one of the proposed sampling locations to the area that coincides with the easternmost debris burial trench identified in Figure 4.

Response: **At the July 22nd RPM meeting, DOE/LLNL proposed alternate drilling locations that included relocating three of the random borehole locations and adding two boreholes within the known debris burial trench locations as requested in DTSC's General Comment #1, EPA's Specific Comment #4, and the RWQCB's General Comment #3.**

Following a discussion at the RPM meeting, DOE and the regulatory agencies agreed that:

- **Six boreholes would be drilled within the known trench locations as requested in regulatory comments.**
- **Six boreholes would be drilled in the locations of the 1990 test pits where metal and/or volatile organic compound (VOC) soil contamination were encountered.**

The regulatory agencies concurred that this approach would result in the highest probability of detecting SVOC, PAH, and PCB contamination, if present, in subsurface

soil in the debris burial trench area.
On August 1, 2014, DOE/LLNL provided a map of the new borehole locations based on this agreed-upon approach. EPA, the RWQCB, and DTSC concurred with the new locations that are presented in Figure 9 of this work plan on August 11 and 12, 2014, respectively.

The text in Section 3.2.1 and Figure 9 have been modified to reflect these changes.

U.S. Environmental Protection Agency Comment Responses:

GENERAL COMMENTS

1. The sampling approach proposed in the EGSA WP is not appropriate for the source of contaminants. For example, polychlorinated biphenyls (PCBs), if present, would be associated with cutting oils that potentially coat metal debris and would only be detected in soil in close proximity to metal debris that was cut in the workshops. Polycyclic aromatic hydrocarbons [PAHs] are likely associated with oils as well and would similarly be present in proximity to metal debris that was cut in the workshops or in stained soils. This indicates that the proposed randomized approach will not provide appropriate data to answer the question regarding whether PCBs and/or PAHs are present. Instead, samples should be collected in proximity to metal debris that was cut in the workshops or from stained soil.

In addition, if there is large debris present and borings hit refusal, some of the planned samples could not be collected. An alternative sampling approach that would address these concerns, and conserve budget, is to use a backhoe to find cut metal debris so soil samples can be collected in close proximity to concentrations of such debris without concerns related to boring refusal and so that stained soil, if present can be identified. EPA doesn't see the value, in the case of the EGSA trenches, to first use geophysical detection devices; rather to proceed with a backhoe for the purpose of efficiency.

Please revise the ESGA WP to change the sampling approach from a randomized design to a focused approach that will answer the question regarding whether PCBs and/or PAHs are present.

Response: **As discussed at the July 22nd LLNL Site 300 RPM meeting, DOE/LLNL appreciates EPA's efforts to conserve budget and evaluated EPA's recommended excavation-based sampling approach in detail. Based on this evaluation, DOE/LLNL had significant concerns with the proposed alternate sampling approach. These concerns that were discussed at the RPM meeting are summarized below.**

Sample Representativeness:

One concern was whether the focused excavation approach would yield a representative sample with which to assess risk and threat to ground water. Due to the uncertainty in the exact coordinates of the debris trenches, and the presence of debris and VOCs outside the known trench locations, using a solely focused (targeted) sampling would be more likely to introduce spatial bias than would the random grid or a combined random-focused sampling approach as recommended by DTSC and the RWQCB. For example, it would not account for any debris and associated contamination outside the known trench locations.

In addition, excavation by backhoe would disturb the metal pieces and soil, complicating efforts to locate stained soil beneath an undisturbed piece of metal from which to collect a sample.

Assessment of Risk and Threat to Ground Water:
DOE/LLNL was also concerned that selective sampling of only soil near metal pieces could skew the assessment of risk and impact to ground water to an unrealistically high exposure point concentration (i.e., 95% upper confidence limit), thereby resulting in a misrepresentation of actual risk or threat to ground water.

Biological Impacts:
One of DOE/LLNL's biggest concerns with the excavation approach is related to biological impacts. Since the test pit excavations were conducted in 1990, all of Site 300, including the Eastern GSA debris burial trench area, has been designated as critical habitat for special status (threatened and endangered) species by the U.S. Fish and Wildlife Service (USFWS). As a result, all soil disturbing work must be assessed for impacts to both the habitat and species.

In anticipation of the drilling work in the Eastern GSA debris burial trench area, DOE/LLNL submitted a Biological Assessment (BA) to the USFWS that outlined short-term impacts and measures to minimize/prevent impacts to the critical habitat and special-status species. The USFWS deemed the impacts of borehole drilling to be relative minor and issued a Biological Opinion (BO).

However, if the approach is changed to a soil excavation approach, the impacts to the critical habitat and special status species could increase significantly. At a minimum, this would delay implementation of the work, while the USFWS BA/BO process is implemented which could take up to a year. It could also result in the USFWS requiring long-term mitigation measures to offset these impacts that would significantly increase costs. For example, the purchase of mitigation credits required by the USFWS for characterization work in the Building 812 area cost $35,000 for an acre of disturbance.

Logistical/Waste Generation and Disposal Impacts
DOE/LLNL also had significant concerns about logistical and potential waste generation/disposal impacts from an excavation approach as it could result in extremely large volumes of soil being removed while searching for metal parts and stained soil that would have to be managed, characterized, and potentially disposed of offsite. If the excavated soil is determined to constitute waste, then significant costs would be incurred.

In addition, if large volumes of soil were required to be excavated to locate appropriate sampling locations, DOE/LLNL was also concerned that this would essentially constitute a removal action/remedy prior to a risk or threat to ground water even being identified

Cost Impacts:
As discussed previously, the USFWS could require costly long-term mitigation measures to offset critical habitat impacts posed by excavation (i.e., purchase of mitigation credits). Significant costs would also be incurred to manage, characterize, and potentially dispose of excavated soil

Schedule Impacts:

The implementation schedule would be delayed by one year (for implementation of the USFWS BA/BO process) to over two years (to request and receive additional funds if FY 2014 funds are not sufficient to conduct this work).

***Auger Refusal*:**

EPA also expressed concern about the drilling/sampling approach in that it could result in some samples not being collected if the auger encounters large metal pieces. However, the statement in the work plan that the boreholes will be drilled to a maximum depth of 15 feet (ft) below ground surface or to auger refusal was referring to refusal related to encountering bedrock. Large pieces of metal are not expected to be encountered based on the information collected during the previous (1990) magnetic/ground penetrating radar (GPR) surveys and test pit excavation. However, if auger refusal is caused by a large metal object, then a sample of the soil cuttings from the refusal depth will be collected and submitted for SVOC, PAH, and PCB analyses. A decision will be made at that time, based on the borehole depth, whether to move over and drill a new borehole in a nearby more favorable location.

It is not likely that unweathered Neroly bedrock will be encountered at or above 15 feet below ground surface in any of the proposed boreholes that will result in auger refusal. However, if bedrock is encountered that results in auger refusal, a decision will be made, based on borehole depth, whether to move over and drill a new borehole in a nearby more favorable location or to collect samples from the deepest portion of this borehole for SVOC, PAH, and PCB analyses.

The drilling geologist will also carefully monitor auger cuttings between sampling depths. If metal debris is encountered, DOE/LLNL will sample the soil cuttings associated with the metal debris for SVOC, PAH, and PCB analyses.

Text was added to Section 3.2.1 (Borehole Drilling) that discusses these procedures to be followed in the event auger refusal is encountered.

Summary:

Given these significant concerns in implementing a focused excavation-based approach, DOE/LLNL concluded that the combined random sampling (to account for debris outside the known trenches) and focused sampling (to target known trenches) as suggested by DTSC and RWQCB would be the better approach.

At the July 22nd RPM meeting, DOE/LLNL proposed alternate drilling locations that included relocating three of the random borehole locations to and adding two boreholes within the known debris burial trench locations as requested in DTSC's General Comment #1, EPA's Specific Comment #4, and the RWQCB's General Comment #3.

Following a discussion at the RPM meeting, DOE and the regulatory agencies agreed that:

- **Six boreholes would be drilled within the known trench locations as requested in**

regulatory comments.

- **Six boreholes would be drilled in the locations of the 1990 test pits where metal and/or VOC soil contamination was encountered.**

The regulatory agencies concurred that this approach would result in the highest probability of detecting SVOC, PAH, and PCB contamination, if present, in subsurface soil in the debris burial trench area.

On August 1, 2014, DOE/LLNL provided a map of the new borehole locations to the regulators based on this agreed-upon approach. On August 11 and 12, 2014, the regulatory agencies concurred with the new locations, which are presented in Figure 9 of this work plan.

The text in Section 3.2.1 and Figure 9 have been modified to reflect these changes.

2. The EGSA WP specifies that if semi-volatile organic compounds (SVOCs), PAHs, and/or PCBs are detected at concentrations above the analytical reporting limit, the potential inhalation risk and potential impact to groundwater will be assessed; however, it is unclear what actions will be necessary at the EGSA if it is determined that concentrations pose an inhalation risk and/or will impact groundwater.

   In addition, it is unclear if extent of contamination will be defined. For example, if the sample collected from 15 feet below ground surface (ft bgs) at a given borehole has elevated concentrations, it is unclear if deeper samples will be collected in the future to define the vertical extent of contamination. Please revise the EGSA WP to specify what actions will be necessary at the Eastern General Services Area (EGSA) if it is determined that concentrations pose an inhalation risk and/or will impact groundwater. In addition, please specify whether it will be necessary to define extent if elevated concentrations are present.

Response: **Decisions, such as whether the collection of deeper or more samples are necessary, will depend on the results of the sample analyses.**

As discussed at the July 22nd LLNL Site 300 RPM meeting, the following process would be followed:

- **If no SVOCs, PAHs, or PCBs are detected in the subsurface soil samples, then no further sampling would be necessary.**
- **If SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above analytical RLs and the sample results indicate the extent of contamination may not be fully defined vertically and/or horizontally, then DOE/LLNL would discuss the need for and type of additional sampling with the regulatory agencies.**
- **If SVOCs, PAHs, and/or PCBs are detected at concentrations above RLs and the sample results indicate the extent of contamination in subsurface soil is defined vertically and horizontally (as defined by non-detections), then DOE/LLNL would**

proceed with the evaluation of the constituent concentrations detected against regulatory screening levels (i.e., EPA soil RSLs).

- **If SVOCs, PAHs, and/or PCBs are detected at concentrations above regulatory screening levels (i.e., EPA soil RSLs) in subsurface soil samples, then DOE/LLNL will evaluate risk and potential threat to ground water associated with these constituents using site-specific data.**

The specific methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies in the event that SVOCs/PAHs, and/or PCBs are detected in the subsurface soil samples.

If SVOCs/PAHs and/or PCBs are detected and are determined to pose an unacceptable risk or threat to ground water above drinking water Maximum Contaminant Levels (MCLs), then DOE/LLNL would follow the CERCLA process to propose and assess remedial alternatives, and select and implement a remedy to mitigate any unacceptable risk or threat to ground water. For example, a Focused Feasibility Study would be prepared that proposes remedial alternatives and a remedy would be selected to address these constituents in an Amendment to the GSA Record of Decision (ROD).

Text has been added to Section 3.2.4 (Data Evaluation) that discusses the processes outlined above.

3. The objectives and scope of work at the beginning of the EGSA WP are missing assessment of direct (dermal) contact (i.e., only volatilization and impact to groundwater are addressed). For example, there are dermal contact issues associated with PCBs. Similarly, the ingestion pathway should be considered for potential future residents, since PCBs or PAHs could adhere to home-grown produce.

   If PCBs are present, then a soil cover needs to be maintained and land use controls (LUCs) implemented to prevent exposure. In addition, both the presence of PAHs and PCBs above the Regional Screening Levels (RSLs) would also require a soil cover and LUCs that preclude excavation. Please revise the EGSA WP to include activities-related assessment of dermal contact and ingestion.

Response: **As discussed at the July 22nd LLNL Site 300 RPM meeting, the work plan objectives/scope did not consider the exposure pathways for dermal contact with PCBs in subsurface soil by onsite workers, or the ingestion of PCBs and PAHs by potential future residents for the following reasons:**

- **The exposure pathways in the conceptual model for contaminants in subsurface soil in the GSA as well as all other OUs at Site 300, and upon which remedies have been selected in the RODs, are based on an industrial land use scenario rather than a residential scenario.**
- **As such, the only potential for exposure to subsurface soil contaminants through dermal contact or ingestion would be to onsite workers during short-term construction projects that involve excavation into subsurface soil.**

- **If SVOCs, PAHs, and/or PCBs are found at potentially harmful levels in subsurface soil, the existing institutional control (IC) that prevents onsite worker exposure during excavation activities could be expanded to include these constituents. (This IC is contained in the GSA OU IC/ land use control (LUC) Table 2.9-13 of the 2008 Site-Wide ROD, and Table 2 of the 2011 GSA Five-Year Review).**
- **Because Site 300 and GSA OU risk assessments have been conducted for an industrial land use, a LUC is also in place that prohibits the transfer of Site 300 property that could cause potential harm under residential or unrestricted land use. (This LUC is contained in the GSA OU IC/LUC Table 2.9-13 of the 2008 Site-Wide ROD, Table 2 of the 2011 GSA Five-Year Review, and the Site 300 Federal Facility Agreement.)**
- **This LUC would prevent residential exposure to SVOCs, PAHs, and/or PCBs in subsurface soil if these constituents are detected at concentrations that exceed residential soil RSLs.**

DOE/LLNL understands that SVOC, PAH, and/or PCB concentrations in subsurface soil above residential soil RSLs would warrant the continuation of the existing LUC that prohibits the transfer of Site 300 property that could cause potential harm under residential or unrestricted land use.

A soil cover is in place over the trenches.

However, the intent of the Work Plan is to describe the sampling methods and approach that will be used to determine if SVOCs, PAHs, and PCBs are present in subsurface soil in the debris burial trench area. As discussed in Step 1 of the Data Quality Objectives Table 1, because SVOC, PAH, and PCB contamination is, at this point, only a possibility, the conceptual model does not address secondary release mechanisms, contaminant migration, or exposure pathways and routes that would become relevant should SVOC, PAH, or PCB contamination be found. Completion of a conceptual model to include these elements will be addressed in follow-up work if such contamination is found.

As discussed in Section 3.2.4, if the sampling results indicate that these constituents are present in subsurface soil, DOE/LLNL will proceed with the evaluation of the constituents detected against regulatory screening levels, and if necessary, assess the risk and threat to ground water using site-specific data.

The specific methods to conduct the evaluation of risk and threat to ground water will be discussed with the regulatory agencies in the event that SVOCs, PAHs, and/or PCBs are detected in the subsurface soil samples.

Therefore, details of a risk assessment (i.e., exposure pathways and routes), that may not be needed, were removed from the work plan to expedite completion of the work plan and implementation of the fieldwork.

4. The EGSA WP does not discuss reporting. The text should indicate whether a report or technical memorandum with results will be produced and should summarize the contents of the report. Please revise the EGSA WP to indicate whether a report or technical memorandum with results will be produced following the completion of the field work and data analysis, and if so, summarize the proposed contents of this report.

Response: **Please refer to the response to DTSC's Comment #6 regarding the process for reporting the results of the EGSA Debris Burial Trench soil sampling.**

SPECIFIC COMMENTS

1. Section 1.3, Summary of Scope of Work, Page 2: The third bullet point states, "If SVOC/PAHs or PCBs are present in subsurface soil, assess the potential for these constituents to volatilize from subsurface soil into outdoor air;" however, PCBs are not volatile at normal temperatures.

   In addition, the last bullet point states "If SVOCs/PAHs are present in subsurface soil, assess the potential for these constituents to impact groundwater;" however, PCBs are not included. Please revise the third bullet point to remove PCBs and revise the last bullet point to include PCBs.

Response: **As discussed in the response to EPA's General Comment #4, details of a risk assessment (i.e., exposure pathways), that may not be needed, were removed from the work plan to expedite completion of the work plan and implementation of the field work. Therefore, the third and fourth (last) bullet in Section 1.3 were revised and combined to state: "If SVOCs, PAHs or PCBs are present in subsurface soil, evaluate the constituents detected against regulatory screening levels, and if necessary, assess the risk and potential threat to ground water using site-specific data."**

2. Section 3.2.1, Borehole Drilling, Page 9: According to the last paragraph of Section 3.2.1, "Any excess sample soil will be containerized in buckets or drums, marked with borehole name, depth, and date;" however, the EGSA WP does not indicate whether any excess soil will be sampled, where it will be disposed, and how it will be handled prior to disposal. Please revise Section 3.2.1 to expand the discussion regarding any excess sample soil that will be containerized.

Response: **Any excess soil cuttings that cannot be returned to the boreholes will be containerized and turned over to the LLNL Radioactive and Hazardous Waste Management (RHWM) Division for characterization and disposal. The soil containers will be placed in an onsite waste accumulation area while awaiting characterization results. RHWM's characterization results for any excess soil cuttings will be used to determine the appropriate soil disposal method. For example, uncontaminated soil will either be reused onsite or disposed at a sanitary landfill. Contaminated soil will be disposed of at an appropriate landfill or disposal facility based on the contaminants and concentrations detected.**

Text has been added to Section 3.2.1 to discuss the handling, characterization, and disposal of any excess soil cuttings that cannot be returned to the boreholes.

3. Section 3.2.1, Borehole Drilling, Page 9 and Section 3.4 Contamination Control and Sampling Equipment Decontamination Procedures, Page 13: Section 3.4 states, "To control contamination, all soil cuttings at borehole drilling sites will be placed in buckets, weather-tight containers, or sealed drums, as discussed in Section 3.2.1;" however, this is inconsistent with Section 3.2.1, which states that "all drill cuttings will be contained in drums or on plastic adjacent to the boreholes." Please revise the EGSA WP to resolve this discrepancy.

Response: **Auger cuttings will be placed on plastic sheeting adjacent to the borehole during drilling and sampling activities. The total volume of cuttings is expected to be less than 2.5 ft^3 per borehole given the 6-inch auger diameter, 15-foot total depth, and amount of soil removed for samples. It is expected that all auger cuttings will be returned to the borehole of origin. As discussed in the response to EPA's Specific Comment #2 above, if there are any excess cuttings that cannot be returned to the borehole, they will be containerized, marked with borehole name, depth, and date, and turned over to the LLNL RHWM Division for characterization and disposal.**

The text in Section 3.2.1 has been modified to provide clarification on the handling of soil cuttings.

4. Section 3.2.1, Borehole Drilling, Page 9 and Figure 9, Proposed borehole subsurface soil sampling locations in the Eastern GSA Debris Burial Trench Study Area: EPA disagrees with the random grid approach (see General Comment 1). However, we are providing this specific comment in the context of the Lab's decision to proceed with the original approach. Section 3.2.1 states, "The exact location of the 12 boreholes will be determined using a 3 x 4, 50 ft square grid that encompasses the 150 ft x 200 ft;" however, Figure 9 does not show the grid. In addition, Figure 9 shows that no boreholes are proposed in the northeastern trench identified from the aerial photographs (i.e., grey shaded areas). Lastly, it is not clear why four boreholes will be drilled along the existing roads. One of these boreholes should be moved to the northeast trench. Please revise Figure 9 to display the sampling grid. In addition, please revise Figure 9 to move one of the four boreholes to be drilled along the existing roads to the northeast trench.

Response: **Please refer to the response to EPA's General Comment #1 regarding the sampling approach and borehole locations.**

5. Section 3.4 Contamination Control and Sampling Equipment Decontamination Procedures, Page 13: Section 3.4 does not indicate whether water used for equipment decontamination will be containerized and where it will be disposed. In addition, the text does not state whether samples will be collected to determine disposal requirements. Please revise Section 3.4 to indicate whether water used for equipment decontamination will be containerized and where it will be disposed. Please also revise Section 3.4 to state whether decontamination water will be sampled for disposal purposes.

Response: **Drilling equipment (i.e., auger flights) and any sampling equipment will be decontaminated between each borehole following guidance provided in ERD Standard Operating Procedure (SOP) 4.5: General Equipment Decontamination; Sampling equipment decontamination (Table 2). As specified in SOP 4.5, this will be done by mechanically removing any soil on the auger flights or sampling equipment to the same plastic sheeting that will contain the drill cuttings. Once any soil has been removed, the auger flights and sampling equipment will be rinsed lightly using site water that will be contained in a drum. At the conclusion of the sampling effort, the decontamination rinse water will be sampled and analyzed for SVOCs/PAHs (EPA Method 625) and PCBs (EPA Method 8082A). If these constituents are not detected above analytical RLs, the rinse water in the drum(s) will be allowed to evaporate. If they are detected, the rinse water drum(s) will be turned over to LLNL RHWM for disposal at the appropriate facility based on the constituents detected and concentrations**.

The text in Section 3.4 has been modified to reflect these procedures.

6. Section 5.0, Schedule, Page 14: Section 5.0 does not include a schedule, but instead indicates that fieldwork will be scheduled following approval of the EGSA WP; however, it is unclear how the schedule will be presented. Please revise Section 5.0 to indicate when a project schedule will be presented.

Response: **The second sentence in Section 5 was revised to state: "A schedule for the sampling and analysis activities will be developed and discussed with the regulators, once regulatory approval of the work plan is received."**

DOE/LLNL cannot provide any further definition of a schedule at this point in time due to the uncertainty in: (1) the length of time required to receive regulatory approval of the work plan, (2) the final scope of work to be performed, (3) availability of funding for the final agreed-upon work scope, and (4) other requirements that are affected by both changes in work scope and the timing of implementation. For example, the USFWS have imposed restrictions that require that the borehole drilling and sampling be completed by October 15, 2014 to minimize impacts to special status species migration during the wet season. If regulatory approval of the work plan is received in time to schedule and complete the drilling and sampling work scope by October 15, the work will be scheduled as soon as drill rig and personnel availability allows. However, if regulatory approval of the work plan is not received in time to schedule and complete the drilling and sampling work scope by October 15, the fieldwork will have to be rescheduled for the spring or summer of 2015. This also assumes that the work scope does not increase to the point where existing Fiscal Year 2014 funds are not sufficient to cover the work.

MINOR COMMENTS

1. Section 3.2.2, Soil Sampling, Page 10: Section 3.2.2 specifies that "a total of four duplicate subsurface soil samples will be collected;" however, the EGSA WP does not discuss other types of quality assurance/quality control (QA/QC) samples, like equipment blanks and matrix spike/matrix spike duplicates (MS/MSDs). It is understood that information regarding

QA/QC sampling is included in Appendix B, but this information should also be summarized in the main text. Please revise Section 3.2.2 to discuss the additional QA/QC samples that will be collected.

Response: **The following text was added to Section 3.2.2: "In addition to duplicate soil samples, additional QA/QC samples to be collected in the field include:**

- **Trip blanks provided by the analytical laboratory that will be submitted with each chain-of-custody sheet.**
- **A field blank to be poured at the sampling location to identify contamination that may occur during the sample collection process.**
- **Equipment (rinsate) blanks collected during the equipment decontamination procedure.**

As described in Section B-1.3.2.2 (Appendix B), the laboratory performing the sample analyses will perform and provide the results for method blank and matrix spike/matrix spike duplicate analyses."

In addition, text was added to discussing the splitting of duplicate samples for inter- and intra-laboratory comparisons.

2. Section 7.0, Acronyms and Abbreviations, Page 16: Section 7.0 defines PAHs as "polyaromatic hydrocarbons;" however, PAHs are polycyclic aromatic hydrocarbons or polynuclear aromatic hydrocarbons. Please revise Section 7.0 to define PAHs as polycyclic aromatic hydrocarbons or polynuclear aromatic hydrocarbons.

Response: **PAHs are also referred to as polyaromatic hydrocarbons[a]. However, the text was revised to define PAHs as "polycyclic aromatic hydrocarbons", as requested.**

Potter, D., and J. Pawilszyn, (1994), *Rapid Determination of Polyaromatic Hydrocarbons and Polychlorinated Biphenyls in Water Using Solid Phase Microextraction and GS/MS*, Environ. Sci. Technol. 1994, 28, 298-305.

Barclay, C., G. Farquhar, and R. Legge, (1995), *Biodegradation and sorption of polyaromatic hydrocarbons by Phanerochaete chrysosporium*, Applied Microbiol. Biotechnol, 42: 958-963.

Xu-Chen Wang, Song Sun, Hai-Quing Ma, Ying Lui, (2006) *Sources of aliphatic and polyaromatic hydrocarbons in sediments in Jiaozhou Bay*, Qingdao, China, Marine Pollution Bulletin, Vol. 52, pg. 129-138.

Regional Water Quality Control Board (RWQCB)-Central Valley Region Comments

1. The second paragraph of Section 2.1 of the Work Plan briefly states that within the GSA are a number of craft shops, storage buildings, and offices that support research being conducted at Site 300. The Work Plan should provide a clearer physical description specific to the Eastern GSA, including the current land use(s) at the Eastern GSA.

Response: **The Eastern GSA area is largely undeveloped. Structures within or near the Eastern GSA include a pond that is used to treat sewage generated by shops and offices in the Central GSA, and an overflow pond east of the sewage pond. Debris burial trenches, that were used to dispose of craft shop debris in the 1960s and early 1970s, are located immediately north of the overflow pond. Other structures present in the Eastern GSA include former ground water extraction and monitor wells and a ground water treatment system that were used to extract, monitor, and treat contaminated ground water prior to the achievement of cleanup standards in 2007. There are also several dirt roads in the area that were constructed to access the sewage and overflow pond, the treatment facility, and the extraction/monitor wellfield. The current land use in the Eastern GSA is industrial. The Eastern GSA, as well as most of Site 300, has also been designated as critical habitat for protected wildlife resources. Offsite property adjacent to the Eastern GSA includes privately owned rangeland and a residence to the south, and an ecological preserve owned by the California Department of Fish and Game.**

This text has been added to Section 2.1 to provide a clearer physical description of the Eastern GSA, including current land use.

2. Regional Water Board staff concur with the overall coverage of sample locations within the estimated boundary of the debris burial area as shown on Figure 9. However, sample coverage within the known locations of the actual burial trenches needs to be increased to ensure that the trenches are sufficiently sampled and hot spots are not missed, and to increase the level of confidence in drawing conclusions about the presence/absence of contamination. Therefore, at least two additional borings should be advanced within the depicted approximately 150 feet long by 25 feet wide trench; at least two additional borings within the approximately 75 feet long by 24 feet wide trench; and at least one boring within the approximately 65 feet long by 24 feet wide trench. Additionally, at least one boring should be placed within each former test pit location where COCs had been detected.

Response: **At the July 22nd RPM meeting, DOE/LLNL proposed alternate drilling locations that included relocating three of the random borehole locations to and adding two boreholes within the known debris burial trench locations as requested in DTSC's General Comment #1, EPA's Specific Comment #4, and the RWQCB's General Comment #3.**

Following a discussion at the RPM meeting, DOE and the regulatory agencies agreed that:

- **Six boreholes would be drilled within the known trench locations as requested in regulatory comments.**
- **Six boreholes would be drilled in the locations of the 1990 test pits where metal and/or VOC soil contamination was encountered.**

The regulatory agencies concurred that this approach would result in the highest probability of detecting SVOC, PAH, and PCB contamination, if present, in subsurface soil in the debris burial trench area.

On August 1, 2014, DOE/LLNL provided a map of the new borehole locations to the regulators based on this agreed-upon approach. On August 11 and 12, 2014, the regulatory agencies concurred with the new locations that are presented in Figure 9 of this work plan.

The text in Section 3.2.1 and Figure 9 have been modified to reflect these changes.

3. The Work Plan does not explain how the proposed number of soil samples will be collected in the event that refusal is encountered due to difficult drilling conditions. The Work Plan should be revised to describe how soil samples will be collected if refusal is encountered prior to samples being collected. For instance, the Work Plan should state whether grab samples will be collected instead, or whether the borehole will be abandoned and an adjacent boring attempted.

Response: **As discussed in the response to EPA's General Comment #1, it is not likely that unweathered Neroly bedrock will be encountered at or above 15 feet below ground surface in any of the proposed boreholes that will result in auger refusal. However, if bedrock is encountered that results in auger refusal, a decision will be made based on borehole depth whether to move over and drill a new borehole in a nearby more favorable location or to collect samples from the deepest portion of this borehole for SVOC, PAH, and PCB analyses.**

As discussed at the July 22nd RPM meeting, large pieces of metal are not expected to be encountered based on the information collected during the previous (1990) magnetic/GPR surveys and test pit excavation. However, if auger refusal is caused by a large metal object, then a sample of the soil cuttings from the refusal depth will be collected and submitted for SVOC, PAH, and PCB analyses. A decision will be made at that time, based on borehole depth, whether to move over and drill a new borehole in a nearby more favorable location.

In addition, the drilling geologist will carefully monitor auger cuttings between sampling depths. If metal debris is encountered, DOE/LLNL will sample the soil cuttings associated with the metal debris for SVOC, PAH, and PCB analyses.

Text was added to Section 3.2.1 (Borehole Drilling) that discusses these procedures to be followed in the event auger refusal is encountered.

4. The Work Plan's scope of work outlined in Section 3.2 does not include borehole logging. Borehole logging is necessary to provide information on the types of lithology/debris encountered during drilling, and to verify the depth of the debris burial area and depth to groundwater if encountered. The Work Plan's scope of work should be revised to state that borehole logging will be conducted and include a description of how borehole logging will be conducted.

Response: **A drilling geologist will be present during the drilling of the boreholes to log the cuttings to provide information on the lithology and any metal or other debris, that are encountered during drilling, and to verify the depth of the debris burial trench. Any soil associated with metal debris will be sampled and submitted for SVOC, PAH, and PCB analyses. DOE/LLNL do not anticipate encountering ground water during drilling, however depth to ground water would be recorded if encountered.**

Text was added to Section 3.2.1 to reflect the information above.

5. The last paragraph of Section 3.2.1. states that boreholes will be backfilled with cuttings of origin and the surface topped with hydrated bentonite. Excess sample soil will be containerized in buckets. The Work Plan should specify how/where the containerized soil will be disposed of.

Response: **The total volume of cuttings is expected to be less than 2.5 ft^3 per borehole given the 6-inch auger diameter, 15-foot total depth, and amount of soil removed for samples. Even accounting for some soil expansion, it is expected that all the soil cuttings can be returned to their borehole of origin.**

However, any excess soil cuttings that cannot be returned to the boreholes will be containerized and turned over to the LLNL Radioactive and Hazardous Waste Management (RHWM) Division for characterization and disposal. The soil containers will be placed in an onsite waste accumulation area while awaiting characterization results. RHWM's characterization results for any excess soil cuttings will be used to determine the appropriate soil disposal method. For example, uncontaminated soil will either be reused onsite or disposed at a sanitary landfill. Contaminated soil will be disposed of at an appropriate landfill or disposal facility based on the contaminants and concentrations detected.

Text has been added to Section 3.2.1 to clarify how the containerized soil will be handled and disposed of.

3. Section 3.2.1, Borehole Drilling, Page 9 and Section 3.4 Contamination Control and Sampling Equipment Decontamination Procedures, Page 13: Section 3.4 states, "To control contamination, all soil cuttings at borehole drilling sites will be placed in buckets, weather-tight containers, or sealed drums, as discussed in Section 3.2.1;" however, this is inconsistent

with Section 3.2.1, which states that "all drill cuttings will be contained in drums or on plastic adjacent to the boreholes." Please revise the EGSA WP to resolve this discrepancy.

Response: **Auger cuttings will be placed on plastic sheeting adjacent to the borehole during drilling and sampling activities. The total volume of cuttings is expected to be less than 2.5 ft^3 per borehole given the 6-inch auger diameter, 15-foot total depth, and amount of soil removed for samples. It is expected that all auger cuttings will be returned to the borehole of origin. However, if there are any excess cuttings that cannot be returned to the borehole, they will be containerized, marked with borehole name, depth, and date, and turned over to the LLNL RHWM Division for characterization and disposal.**

The text in Section 3.2.1 was modified to resolve this discrepancy.

6. Section 3.4 of the Work Plan references the ERD SOP 4.5 for procedures to be followed for decontamination of drilling equipment. However, ERD SOP 4.5 contains at least five decontamination procedures. The Work Plan needs to specify which of the decontamination procedures listed in the SOP will be followed.

Response: **The decontamination procedure 6.2.2 (Decontamination by Rinsing) in the LLNL Environmental Restoration Department's (ERD) SOP 4.5 will be used for decontamination of drilling and sampling equipment (i.e., auger flights) between each borehole. As specified in this procedure, decontamination will be done by mechanically removing any soil on the auger flights or sampling equipment to the same plastic sheeting that will contain the drill cuttings. Once any soil has been removed, the auger flights and sampling equipment will be rinsed lightly using site water that will be contained in a drum. At the conclusion of the sampling effort, the decontamination rinse water will be sampled and analyzed for SVOCs/PAHs (EPA Method 625) and PCBs (EPA Method 8082A). If these constituents are not detected above analytical RLs, the rinse water in the drum(s) will be allowed to evaporate. If they are detected, the rinse water drum(s) will be turned over to LLNL RHWM for disposal at the appropriate facility based on the constituents detected and concentrations**.

The text in Section 3.4 and Table 2 have been modified to reflect these procedures.

C-2. Responses to Regulatory Comments on the Draft Final Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches

California Department of Toxic Substances Control (DTSC) Comments

DTSC has reviewed the Draft Final Characterization Work Plan for Subsurface Soil in the Eastern General Services Area, Debris Burial Trenches, Lawrence Livermore National Laboratory Site 300, dated August 2014. DTSC's comments have been addressed satisfactorily; DTSC has no additional comments. Please submit a clean copy of the Final Characterization Work Plan.

DOE Response: **DOE appreciates and notes DTSC's concurrence with the work plan.**

U.S. Environmental Protection Agency Comment Responses:

EPA Comment on DOE's Response to EPA's General Comment 4 on the Draft Work Plan: The response partially addresses the comment. Although the concerns regarding the excavation approach and its biological impacts are valid, the response does not adequately address the concerns regarding sampling in proximity to machined metal debris. As stated in the original comments, cutting oils that potentially contained polychlorinated biphenyls (PCBs) would be associated with the machined metal debris, so if none of the samples are collected in proximity to metal debris then non-detects are meaningless (i.e., the non-detects do not indicate lack of contamination at the site, but instead indicate a lack of contamination in areas not adjacent to metal debris). Please revise the response to indicate the importance of sample collection in proximity to machined metal debris. Please also revise the Draft Final Characterization Work Plan for Subsurface Soil in the Eastern General Services Area, Debris Burial Trenches, Lawrence Livermore National Laboratory Site 300 (the DF EGSA WP) to indicate that soil samples will be collected in proximity to machined metal debris or to specify the percentage of samples that must be collected in proximity to machined metal debris.

DOE Response: **Text in Section 3.2.1 of the Draft Final Characterization Work Plan had already been revised in the draft final work plan to state that: "A drilling geologist will be present during the drilling of the boreholes to log the cuttings to provide information on the lithology and any metal or other debris that are encountered during drilling, and to verify the depth of the debris burial trench. Any soil associated with metal debris will be sampled and submitted for semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), and PCB analyses." As discussed in DOE's e-mail to EPA on September 15, there is not sufficient Fiscal Year 2014 funding or time (due to the U.S. Fish and Wildlife Service [USFWS] October 15 deadline) to continue to drill additional boreholes searching for metal pieces if none are encountered in the planned 12 boreholes. Therefore, in the event that metal is not encountered in the 12 boreholes, DOE will discuss the need for additional borehole drilling and sampling with EPA.**

Text was added to the 1st paragraph of Section 3.2.2 and to Step 7 in Table 1 (DQOs) which states that: "Additional soil samples will be submitted for analysis if metal debris is encountered at any depth in the borehole."

In addition, text in Section 3.2.4 of the Final Work Plan was modified to state that: "Analytical data obtained for the subsurface soil samples collected in the debris burial trench area will be evaluated for SVOC, PAH, and PCB concentrations to determine the next steps to be taken.

These results will be considered as sufficient evidence that there is no risk to human health or threat to ground water associated with these constituents if:

- **SVOCs, PAHs, and PCBs are not detected at concentrations above the analytical reporting limit (RL) in any subsurface soil sample.**
- **The samples include soil collected near metal debris encountered in the boreholes.**

The investigation of the Eastern GSA Debris Burial Trenches will then be considered completed and no further action (i.e., additional soil sampling) for these constituents will be taken.

If SVOCs, PAHs, and PCBs are not detected at concentrations above the analytical RL in any subsurface soil sample, but no metal is encountered in any of the boreholes, DOE will discuss the need for additional borehole drilling and sampling with EPA."

EPA Comment on DOE's Response to EPA's General Comment 4 on the Draft Work Plan: The response addresses the comment; however, the response indicates that if no SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples the data will be presented in a Technical Memorandum attached as an appendix to the Final Closeout Report for the Eastern General Services Area. If the Technical Memorandum is attached to a final document, it is not clear whether the regulatory agencies will have adequate time to review the results of the Eastern GSA investigation. It is suggested that the Technical Memorandum be submitted in draft form for regulatory agency review; the revised Technical Memorandum can then be attached to the Final Closeout Report for the Eastern GSA once comments are addressed. Please revise the response to clarify how the regulatory agencies will have time to review the results of the Eastern GSA investigation since the Technical Memorandum will be attached to a final document.

DOE Response: **As discussed in DOE's e-mail to EPA on September 15, if no SVOCs, PAHs, and/or PCBs are detected in subsurface soil samples at concentrations above their analytical reporting limits (RLs), the sampling effort and data will be presented in a Technical Memorandum that will be forwarded in draft for regulatory review and comment. Once approved, it will eventually be included as an appendix in the Final Close Out Report for the Eastern GSA. The text in the second paragraph of Section 4 (Summary and Next Steps/Process) has been modified accordingly.**

EPA Response to Specific Comment 5: The response addresses the comment; however, the response indicates that sampling equipment "will be rinsed lightly using site water," and it is unclear to what "site water" refers. Deionized water should be used to decontaminate small sampling equipment (e.g., split spoon inserts, trowels, knives, etc.) to ensure there is no cross contamination between sampling locations. Please revise the response to specify that deionized water will be used to rinse small sampling equipment.

DOE Response: **As discussed in DOE's e-mail to EPA on September 15, "Site water" referenced in Section 3.4 refers to water pumped from the onsite water-supply Well 20. This water will be used to decontaminate larger equipment. Deionized water will be used to rinse small sampling equipment during this effort, as indicated in EPA's comment. The text in the 4th sentence of the last paragraph of Section 3.4 (Contamination Control and Sampling Equipment Decontamination Procedures) was modified accordingly.**

Regional Water Quality Control Board (RWQCB)-Central Valley Region Comments

Staff of the Central Valley Regional Water Quality Control Board (Regional Water Board) have reviewed the August 2014 *Draft Characterization Work Plan for Subsurface Soil in the Eastern General Services Area Debris Burial Trenches*, *Lawrence Livermore National Laboratory Site 300* (Work Plan). Regional Water Board staff previously submitted comments on the draft version of the Work Plan on 25 July 2014. Those comments were adequately addressed and we concur with the investigation as presented in the Work Plan

However, Regional Water Board staff have conducted a file review of the following historical documents:

- April 1994 Final Side-Wide Remedial Investigation Report;
- October 1995 Final Feasibility Study (FS) for the GSA Operable Unit;
- 28 June 1995 Regional Water Board Comments on the Draft FS for the GSA Operable Unit; and
- 2 October 1995 Regulatory Comment Response Tracking Sheet.

Our review shows that:
1. Specific Comment No. 2 of the 28 June 1995 Regional Water Board comment letter ("*Page 1-22, Section 1.4.2. The debris burial trench near the sewage treatment overflow pond is a confirmed release site. LLNL should state and document if the trench continues to be a source of contamination to ground water and/or soil")* requested LLNL to determine if the trenches by the overflow pond were a continuing source of TCE contamination to groundwater and soil (see attached).

2. LLNL stated in the comment tracking sheet that the Regional Water Board comment was addressed on Page 1-20 of the Feasibility Study as follows (see attached):

"*During the GSA characterization work, an additional potential release site was identified: a debris burial trench located northwest of the sewage treatment pond.* ***Existing data are insufficient*** *to determine whether this debris burial trench continues to act as a source of contamination to soil and/or ground water*" (emphasis added)

Regional Water Board staff consider that LLNL was not responsive to the original comment on the Draft FS. Secondly, the additional debris burial trench located northwest of the sewage pond has not been sufficiently investigated.

Therefore, Regional Water Board staff do not concur with the statement presented in the second paragraph of Section 3.2.4 of the Work Plan, which states that if PCBs and SVOCs are not detected during the proposed soil investigations, investigation of the Eastern GSA Debris Burial Trenches will be considered completed and no further action (i.e. additional soil sampling) will be taken.

Prior to obtaining site closure, LLNL will need to perform soil gas sampling to determine if the trenches that were the documented source of the Eastern GSA TCE plume remain a potential source of groundwater and/or soil pollution. Also, LLNL needs to document the status of the debris trench located northwest of the sewage pond.

DOE Response: **DOE appreciates and notes RWQCB's concurrence with the work plan. The text in Section 3.2.4 was modified to state that: "Analytical data obtained for the subsurface soil samples collected in the debris burial trench area will be evaluated for SVOC, PAH, and PCB concentrations to determine the next steps to be taken.**

These results will be considered as sufficient evidence that there is no risk to human health or threat to ground water <u>associated with these constituents</u> if:

- **SVOCs, PAHs, and PCBs are not detected at concentrations above the analytical reporting limit (RL) in any subsurface soil sample.**
- **The samples include soil collected near metal debris encountered in the boreholes. (Note: added per EPA comment)**

The investigation of the Eastern GSA Debris Burial Trenches will be considered completed and no further action (i.e., additional soil sampling) for these constituents will be taken."

Text in Table 1, Steps 2 and 5, was also modified to specify that if all soil sample results are below analytical laboratory RLs, then SVOCs/PAHs and PCBs will be considered to be not present in the study area, and no further work <u>(i.e., additional soil sampling) for these constituents</u> will be necessary.

In addition, DOE plans to give a presentation at a future Remedial Project Manager's (RPM) meeting to discuss the results of the SVOC, PAH, and PCB soil sampling at the Eastern GSA Debris Burial Trenches. At that time, DOE will also present other information relevant to the RWQCB concerns including:

- **The sufficiency of data to demonstrate that the Eastern GSA debris burial trenches by the sewage treatment overflow pond are a not continuing source of VOC contamination to groundwater and soil.**
- **The investigation and remediation in the vicinity of the debris burial trench located northwest of the sewage pond (This debris burial trench is located in and addressed by remedial actions in the Central GSA).**

General DOE Note on Final Work Plan:

To reflect current status of the fieldwork and work plan, the second two sentences of Section 5 (Schedule) from the draft final work plan were replaced with the following text in the final work plan:

> **"The U.S. Fish and Wildlife Service Biological Opinion requires that the soil sampling outlined in this work plan be completed by October 15, 2014. The DTSC and RWQCB agreed that their comments on the draft final version of this Work Plan have been adequately addressed on September 8, 2014 and September 17, 2014 respectively. On September 18, 2014, the U.S. EPA agreed with the DOE/LLNL**

approach of going forward with the sampling while continuing to finalize this Work Plan. The subsurface soil sampling outlined in this Work Plan began on September 22, 2014."